

RCRA Facility Investigation Work Plan

for the

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	■ Bayer ETS Screening Method for TDI
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ACRONYMS AND ABBREVIATIONS

ACO	Administrative Consent Order
ASTDR	Agency for Toxic Substances and Disease Registry
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
CAP	Community Advisory Panel
CMP	Corrective Measures Proposals
CMS	Corrective Measures Study
COD	Chemical Oxygen Demand
CRP	Community Relations Plan
DMP	Data Management Plan
DOCC	Description of Current Conditions
EC ₅₀	concentration associated with effects in 50 percent of organisms
EPA	United States Environmental Protection Agency
FOL	Field Operations Lead
FSP	Field Sampling Plan
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HON	Hazardous Organic NESHAP
HSWA	1984 Hazardous and Solid Waste Amendments
IRIS	Integrated Risk Information System
LC ₅₀	lethal concentration for 50 percent of organisms
LEPC	Local Emergency Planning Committee
LOAEL	Lowest Observed Adverse Effect Level
MACT	Maximum Achievable Control Technology
NESHAP	National Emission Standard for Hazardous Air Pollutants
NOAEL	No Observed Adverse Effect Level
ORSANCO	Ohio River Sanitation Commission
PIE	Pre-Investigation Evaluation of Potential Corrective Measures Technologies
PMP	Project Management Plan
PPG	PPG Industries, Inc.
QA/QC	Quality Assurance and Quality Control
QAPP	Quality Assurance Project Plan
RA	Risk Assessment
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SWMUs	Solid Waste Management Units
TOC	Total Organic Carbon
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
VOCs	Volatile Organic Compounds
VOHAP	Volatile Organic Hazardous Air Pollutants
WVDEP	West Virginia Department of Environmental Protection

1.0 INTRODUCTION

This work plan provides the site characterization methods and procedures to be followed during the implementation of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the Bayer Corporation (Bayer) facility located in New Martinsville, West Virginia. Prior to a name change on April 3, 1995, Bayer was known as Miles, Inc. (Miles) and before 1992, Miles was known as Mobay Chemical Corporation (Mobay).

The implementation of this RFI work plan will identify the nature and extent of chemicals found in concentrations that could potentially pose a risk to human health or the environment. The RFI will also collect data needed for the Corrective Measures Study (CMS), which will evaluate potential corrective measures alternatives to reduce any potential risks to acceptable levels.

1.1 OVERVIEW OF REGULATORY FRAMEWORK

Bayer is under both an Administrative Order on Consent (ACO) (Docket No. RCRA-III-004-AM) [EPA (Winett, H.), 1986] and a Permit for Corrective Action and Waste Minimization under the Hazardous and Solid Waste Amendments (HSWA) of 1984 (HSWA Permit No. WVD 05 686 6312) [EPA (Wassersug, S.), 1987]. The United States Environmental Protection Agency (EPA) Region III was the cosigner on the ACO and issuer of the HSWA Permit [EPA (Winett, H.), 1986; EPA (Wassersug, S.), 1987]. The details of the requirements of the ACO and HSWA permit are provided in the facility's Description of Current Conditions (DOCC) Report dated February 28, 1995 (ICF Kaiser, 1995a). Completion of the RFI and ensuing CMS will fulfill requirements set forth in the HSWA permit. In addition to fulfilling HSWA requirements, the remaining requirement of the ACO, a Corrective Measures Proposal (CMP), will be fully addressed. Because the CMS and the CMP have the same objectives, Bayer, EPA Region III, and the West Virginia Department of Environmental Protection (WVDEP) agreed to consolidate the CMS and CMP, and agreed that future work will proceed in accordance with the HSWA permit [Miles (Owens, D.), 1993].

1.2 RFI WORK PLAN OBJECTIVES

The objectives of this work plan are to provide the procedures and quality assurance and quality control (QA/QC) necessary for collecting the information needed to characterize the following:

- Nature and extent of any releases that pose unacceptable risks to human health or the environment from 30 Solid Waste Management Units (SWMUs) included in the RFI (proposed in the DOCC [ICF Kaiser, 1995a] and approved by EPA [EPA, 1995]);
- Potential migration pathways of any releases that pose unacceptable risks to human health or the environment; and
- Criteria for and scope of potential corrective measures needed to reduce any identified risks to acceptable levels.

1.3 DESCRIPTION OF CURRENT CONDITIONS (DOCC) REPORT

A DOCC Report for the Bayer facility was prepared and submitted to EPA Region III and WVDEP on February 28, 1995. The DOCC Report contained the following information, which was used as a basis for developing the scope of work outlined in subsequent sections of this RFI work plan:

- site location and surrounding land use;
- site history;
- regional and site specific hydrogeology/geology;
- past and current waste management practices;
- location of past and current potential sources for soil and groundwater contamination;
- a summary of soil quality data on a SWMU by SWMU basis;
- a summary of groundwater quality data on a sitewide basis;
- a summary of surface water quality data;
- a proposed groundwater monitoring plan;
- past corrective actions; and
- data needs for the RFI, risk assessment, and CMS.

The DOCC Report described 126 units which have been identified at the New Martinsville facility: 124 units documented in previous reports and two other units recently identified by Bayer. The DOCC Report summarizes and incorporates all of the available technical information regarding the units and justifies their inclusion in or exclusion from the RFI. Based on the information presented in the DOCC Report, 96 units identified at the Bayer facility will not be investigated as part of the RFI because they 1) are covered under another permit or other regulatory agency, 2) have been already characterized as not needing corrective action, or 3) have been remediated. The units that are excluded from the RFI are discussed in Appendix A of the DOCC Report. The 30 SWMUs included in the RFI are listed on Table 1-1 and are discussed in detail in Section 3 of the DOCC Report. Figure 1-1 is a plant base map that provides the location of the 30 SWMUs and previous test borings drilled at the facility. Additional discussion of the borings contained on Figure 1-1 is provided in Section 3 of the DOCC Report.

The DOCC Report established that the most logical approach for the RFI is to investigate soil conditions at each of the 30 SWMUs on an individual or SWMU group basis and groundwater on a sitewide basis, and that sufficient groundwater data exists to meet RFI site characterization and risk assessment data needs. The DOCC recommended surface water and sediments be excluded from the RFI because Bayer maintains hydraulic control of site groundwater and sampling did not detect contamination other than low levels of VOCs or SVOCs thought to be associated with blank contamination.

The DOCC Report was approved by EPA in a letter to Bayer dated August 7, 1995 with a requirement to address their comments on Sections 4 and 5 of the DOCC Report in the preparation of the RFI Work Plan. The issues/comments EPA identified as requiring resolution are summarized as follows:

1. EPA indicated that surface water and sediments of Beaver Run must be included in the RFI due to their proximity to the Ash Lagoon, and perched water seeps and groundwater discharge from the South Landfill area;
2. EPA required some changes to the monitoring points and the analytical parameter lists in the proposed groundwater monitoring plan (Section 5 of the DOCC). EPA stated that LF-4S

TABLE I-1

SWMUs INCLUDED IN THE RFI WORK PLAN

SWMU	Location	Operating Status
1. South Landfill	South Landfill Area	Inactive
2. Sludge Lagoon	South Landfill Area	Inactive
3. Fill Area Hydroblasting Station	South Landfill Area	Inactive ¹
4. Ash Lagoon	South Landfill Area	Inactive
5. Residue Fill Area 3F-c	Equalization Basin/Rain Water Lagoon	Inactive
6. Residue Fill Area 3F-d	Clarifier/Biooxidation Tank Area	Inactive
7. Fill Materials Block 21	Block 21	Inactive
8. All Purpose Burning Pit	Block 21	Inactive
9. Residue Fill Area 3F-e	Block 21	Inactive
10. Infilled Wastewater Ditch (Former Process Trench)	Throughout facility	Inactive
11. Acid Neutralization Facility 5F-g	Block 21	Inactive
12. Former Neutralization Spill Basin	Block 22	Inactive
13. Existing Process Trench	Throughout facility	Inactive
14. Fill Materials Block 11	Block 11	Inactive
15. Neutralization and Settling Basin 5F-a	Block 14	Inactive
16. Block 24 Neutralization Basin 5F-e	Block 24	Inactive
17. Polyol Area	Block 24	Active
18. Lab Area 24A	Block 24	Active
19. Residue Fill Area 3F-a	Block 13	Inactive
20. Nitrations Neutralization Settling Basin 5F-b	Block 16	Inactive
21. Nitrations Neutralization Settling Basin 5F-c	Block 16	Inactive
22. Vortex Burner	Block 26	Inactive
23. TDI Area 26B	Block 26	Active
24. Neutralization Trench/Basin 5F-d	Block 15	Inactive
25. HCl Area 15C	Block 15	Active
26. Former Waste Disposal Incinerator	Block 5	Inactive
27. Mononitrobenzene Area	Blocks 17 and 27	Active
28. Iron Oxide Area 28A	Block 28	Active
29. Fill Area Block 28	Block 28	Inactive
30. Residue Fill Area 3F-b	Parking Lot East of Route 2	Inactive

¹ Rarely used as an emergency back-up equipment cleaning area.

and LF-4D must be included in the plan, the organic analyte list must include all chemicals ever detected including tentatively identified compounds (TICs) and metal compounds; and

3. EPA had comments on the Quality Assurance Project Plan (QAPP) related to quality assurance objectives, sampling procedures, analytical procedures, and data validation.

Bayer concurs with EPA that surface water and sediments in Beaver Run may need to be investigated; however, this decision should be made after the RFI fully characterizes the Ash Lagoon and South Landfill. If the RFI determines impacts to Beaver Run from these SWMUs at levels of potential concern, then surface water and sediments in Beaver Run will warrant investigation.

Bayer revised the proposed monitoring plan (Section 5 of the DOCC Report) in accordance with EPA's comments, and resubmitted it on August 21, 1995. Bayer is planning to implement the revised monitoring plan beginning in the fourth quarter, 1995. EPA's issues/comments related to the QAPP are addressed within the Appendices of this RFI Work Plan.

1.4 PAST ENVIRONMENTAL REPORTS

In addition to the DOCC Report, EPA's letter approved five reports discussed in Section 3.4 of the DOCC that were submitted by Bayer to EPA between February 1988 and June 1989 as required by the HSWA Permit. The five reports were:

1. RCRA Facility Assessment (RFA) Report dated June 28, 1988 (IT, 1988a)
2. Flood Release Study, as amended on August 1, 1988 (IT, 1988b)
3. Storm Sewer System Report dated February 12, 1988 (Mobay, 1988a)
4. Air Monitoring Plan, Revision 2 dated June 1989 (Mobay, 1988b)
5. Existing Process Trench Report dated June 20, 1988 (IT, 1988c)

The RFA SWMUs were addressed in the DOCC Report, and the recommendations in the Flood Release Study and Existing Process Trench Report will be addressed through the RFI/CMS process. The storm sewers are regulated under the NPDES and no further action for the storm sewers was identified in the report (Mobay, 1988a).

The target compounds of the study in the Air Monitoring Plan, benzene and trichloroethylene are no longer used in any process in the New Martinsville facility. Air emissions of other contaminants from the wastewater treatment plant will be permitted under the facility's Title V operating permit and controlled under Title III maximum achievable control technology standards (MACT). The MACT standard that is most relevant to New Martinsville is the Hazardous Organic National Emission Standards for Hazardous Air Pollutants (NESHAP) (HON) (40 CFR Part 63, Subparts F through I). Under the HON rule, the volatile organic hazardous air pollutants (VOHAP) emissions from the synthetic organic chemical manufacturing industry's wastewater are specifically regulated. In addition, these emissions are also regulated under RCRA in 40 CFR Part 264, Subparts AA, BB, and CC and under the State of West Virginia's Air Toxics Rule (45 CSR 27). Therefore, the original intent for developing an Air Monitoring Plan is now covered by specific regulations which make the Air Monitoring Plan no longer necessary.

1.5 WORK PLAN ORGANIZATION

Section 2 of this work plan provides the RFI scope of work, risk assessment procedures, and a summary of RFI data needs. The RFI Field Sampling Plan (FSP), which provides the field procedures to be implemented during the RFI, is contained in Section 3. A Project Management Plan (PMP) and Community Relations Plan (CRP) were also developed and are included in Sections 4 and 5, respectively. In conjunction with the submittal of the DOCC Report discussed in Section 1.3, a Quality Assurance Project Plan (QAPP), Data Management Plan (DMP) and a Pre-Investigation Evaluation of Corrective Measures Technologies (PIE) were also prepared and submitted to EPA under separate cover on February 27, 1995 (ICF Kaiser, 1995b, c, and d). Appendix A contains the RFI Health and Safety Plan. Standard operating procedures that were not included in the QAPP but area needed for the RFI are included in Appendix B-1, Appendix B-2 contains responses to EPA's comments on the QAPP, and Appendix B-3 contains the sections of the QAPP that were revised to address EPA's comments. The QAPP document will be amended and redistributed upon EPA approval of the QAPP response to comments (Appendix B-2) and QAPP Revisions (Appendix B-3).

2.0 RFI SCOPE OF WORK

2.1 RFI OBJECTIVES

The objectives of the RFI are to collect the appropriate site environmental information needed to:

- Define the nature and extent of any releases posing potential risk to human health or the environment;
- Identify potential migration pathways of any releases that pose unacceptable risk to human health or the environment;
- Characterize the potential risks to human health and the environment posed by exposure to the various affected media; and,
- Evaluate the potential remedies that could reduce these potential risks to acceptable levels.

2.2 GENERAL APPROACH

The general approach to completing the RFI will be to conduct the investigation in a series of phases, and where it makes sense, to group SWMUs together during the RFI to facilitate data collection. This approach will allow for a focused implementation of the RFI and will maximize the benefit of data collected in the early stages of the RFI. After each phase of investigation and data evaluation, Bayer may regroup or prioritize SWMUs for subsequent investigative phases if data evaluation indicates it is logical to do so. Risk assessment will be one of the key compounds used to determine SWMU groupings.

2.2.1 Evaluation of Soil and Groundwater

Based on the review of existing site information presented in the DOCC Report (ICF Kaiser, 1995a), the RFI approach will be to evaluate groundwater conditions on a sitewide basis, and soil conditions

on a SWMU by SWMU or SWMU Group basis. With the exception of the lagoon water and sediments present in SWMU 4, the Ash Lagoon, surface water and sediments are not considered media of concern. Bayer will further investigate surface water and sediment in Beaver Run only if the RFI concludes there is a potential impact on surface water or sediments at levels of potential concern from the facility's SWMUs.

Past groundwater data show that a complex, intermingled, plant-wide plume containing organic constituents is present beneath the facility. The complexity of the groundwater plume may have resulted from releases from multiple potential SWMUs, making it difficult to relate the contamination to a single source. Also, changes in flow directions beneath the facility caused by variations in both pumping center locations and rates throughout the facility's history further complicate attempts to link the groundwater contamination to individual sources. As a result of these factors, it is impossible to relate groundwater contamination observed at the facility to individual SWMUs based on the results of groundwater samples. No benefit would be gained during the RFI by installing additional monitoring wells next to individual SWMUs where groundwater contamination is already known to exist.

The RFI approach for evaluating whether a SWMU is a potential contributor to the groundwater contamination beneath the Bayer facility will be to gather the appropriate soil analytical information at individual SWMUs or groups of SWMUs to determine whether the SWMU(s) are continuing sources of chemicals leaching to groundwater in concentrations that pose unacceptable risk to human health or the environment. At SWMU 4, the Ash Lagoon, the potential for the lagoon water and sediments to release chemicals to groundwater at concentrations of concern will also be evaluated.

2.2.2 Project Phasing

Three phases of field investigation activities will be completed prior to compiling the final RFI report. Table 2-1 provides an overview of the RFI project phases and tasks. Figure 2-1 provides a detailed summary of the RFI tasks to be conducted under each phase, and the data to be collected under each task.

Phase 1 of the RFI, termed the "Site Reconnaissance and Groundwater Evaluation" consists of RFI Tasks 1 through 4. Tasks 1 through 3 are designed to provide additional information on

TABLE 2-1
OVERVIEW OF RFI PHASES AND TASKS

PHASE 1	SITE RECONNAISSANCE AND GROUNDWATER EVALUATION
Task 1	Historical Aerial Photo/Drawing Review and Site Survey
Task 2	Geophysical Surveys <ul style="list-style-type: none"> ▪ Ground Penetrating Radar Surveys ▪ Electromagnetic Surveys
Task 3	Soil Gas Surveys
Task 4	CMS Groundwater Sampling
PHASE 2	NATURE AND EXTENT INVESTIGATION
Task 5	Confirmatory Test Borings and Soil Sample Collection
Task 6	Concrete Sample Collection
Task 7	Lagoon Water/Sediment Sample Collection
PHASE 3	SOURCE CONFIRMATION/INITIAL ASSESSMENT OF NATURE AND EXTENT INVESTIGATION
Task 8	Surface and Subsurface Sample Collection

environmental conditions at each SWMU using historical aerial photos/drawings, visual site surveys, and rapid field reconnaissance methods. The results of Tasks 1 through 3 will be used to focus sampling efforts during Phase 2. In conjunction with the site reconnaissance tasks, Task 4 will be initiated during Phase 1 of the RFI to collect the data needed to complete the CMS for groundwater. As a result of the large amount of groundwater information Bayer has collected since the mid-1980s, groundwater will need to be analyzed for only a few parameters under Task 4.

Phase 2, the "Source Confirmation/Initial Assessment of Nature and Extent Investigation", will make use of the results from Phase 1 as an aid in refining sample locations and depths. During Phase 2, most sample locations will be biased toward areas of highest suspected contamination as determined by the Phase 1 results and historical sample information presented in the DOCC report. Collecting samples at locations suspected to represent "worst case" conditions will provide biased data that will be used in the conservative screening-level risk assessment described in Section 2.2.3. In addition to samples collected in areas of highest suspected contamination, some samples will be collected to confirm clean areas to provide information on the extent of contamination.

The scope of Phase 3, the "Nature and Extent Investigation", will depend upon the results from both Phases 1 and 2. Those SWMUs found to need additional data after reviewing Phase 2 results will be further characterized during Phase 3. At the conclusion of Phase 3, all the SWMUs will have been appropriately characterized to fulfill the RFI objectives, and sufficient data will have been collected to determine whether surface water and sediments in Beaver Run warrant further investigation.

This Work Plan provides a well defined scope of work for Phases 1 and 2. The scope of work for Phase 3, the Nature and Extent Investigation, will be highly dependent upon the findings of Phases 1 and 2; therefore, a detailed scope of work for Phase 3 cannot be provided in Work Plan. The details for Phase 3 will be provided after Phases 1 and 2 data have been collected and evaluated. This phased approach will allow Bayer to prioritize and focus its resources during Phase 3 on SWMUs that are identified by Phases 1 and 2 to pose the greatest potential risk to human health or the environment. The schedule for implementation and completion of the RFI is presented in Section 4.

2.2.3 Risk Assessment

This subsection of the RFI work plan presents the planned approach for incorporating risk assessment into the overall investigation. The assessment of potential risks to human health and the environment is a critical component in the interpretation of investigation data and in the RFI decision-making process. Thus, a "risk-driven" approach has been developed to facilitate successful implementation of the RFI.

Consistent with the overall RFI approach, the risk assessment will evaluate soil conditions on a SWMU-by-SWMU (or SWMU Group) basis and groundwater conditions on a sitewide basis. At one SWMU (SWMU 4, the Ash Lagoon), lagoon water and sediment will also be evaluated.

The primary purpose of the risk assessment is to identify those SWMUs that may require interim actions, monitoring, or remediation and those that require no action. The assessment of the SWMUs will be conducted in a manner consistent with standard risk assessment methodologies, and that also supports the phased approach to the overall RFI. Risk assessment will serve as a mechanism to aid in prioritizing SWMUs for further evaluation in the RFI. Following completion of the Phase 2, the Source Confirmation/Initial Assessment of Nature and Extent Investigation, a screening-level risk assessment (discussed below) will be employed to determine which SWMUs are to proceed to Phase 3, the Nature and Extent Investigation.

Historic groundwater elevation and chemical analytical data show that Bayer maintains hydraulic capture of affected groundwater beneath their facility. As a result, there are no known exposure pathways to the groundwater and a detailed quantitative risk assessment of groundwater should not be needed during the RFI.

2.2.3.1 General Approach

A Baseline Risk Assessment will be conducted for the Bayer facility consisting of both a human health risk assessment and an ecological evaluation. As a result of the limited ecological habitat on the facility and the lack of migration pathways to the Ohio River, a very focused ecological evaluation of the facility will be conducted.

The media that will be considered in the Baseline Risk Assessment will include soil at all 30 RFI SWMUs, and lagoon water and lagoon sediment at SWMU 4, the Ash Lagoon. Because the Bayer facility is an active industrial facility and will likely remain so for the foreseeable future, all risk assessments conducted at the facility will be based on the assumption of future industrial use. In addition, the qualitative risk assessment of groundwater will assume that current pumping conditions at the facility represent baseline conditions.

A phased approach to the Baseline Risk Assessment of the SWMUs will be employed that helps ensure that high-priority areas are identified, newly-identified data gaps are filled, and redundancy and unnecessary data collection are minimized. Two phases of risk assessment are planned to evaluate the RFI SWMUs. The first phase will consist of a Screening-level Risk Assessment to be performed after data collection in the Phase 2 Source Confirmation/Initial Assessment of Nature and Extent Investigation. The purpose of this Screening-level Risk Assessment will be to categorize SWMUs into the following three groups:

- **Group A:** SWMUs containing chemicals at levels that clearly pose no unacceptable risks.
- **Group B:** SWMUs containing chemicals at levels that may pose unacceptable risks.
- **Group C:** SWMUs containing chemicals at levels that likely pose unacceptable risks.

The Screening-level Risk Assessment of the SWMUs will consist of a comparison of biased Phase 2 analytical results to conservative risk-based screening criteria. If all detected constituents are less than these criteria, then the site will be recommended for no further investigation and no further action (Group A SWMUs). If the concentrations detected exceed risk-based screening criteria by a wide margin, then further investigation, and possibly interim actions, will be recommended (Group C SWMUs). If the concentrations of a few chemicals are in excess of the criteria by a small margin, then the site will be put on a low priority for further investigation (Group B SWMUs). The latter group of sites may be recommended for a more detailed risk assessment to determine the need for further investigation/action.

Risk-based screening-criteria have been selected to evaluate all relevant environmental media, which include soils at all the SWMUs, lagoon water and lagoon sediment at SWMU 4 (the Ash Lagoon), and groundwater on a sitewide basis. The screening criteria have also been selected to evaluate

ingestion, which is the most significant potential exposure pathway associated with these media. The risk-based screening criteria will include the following:

- EPA Region III *Risk-based Concentrations* for soil and water (EPA Region III, 1995);
- Draft EPA *Soil Screening Levels for Superfund* based on migration to groundwater;
- EPA Sediment Quality Criteria;
- Ontario Sediment Quality Guidelines NOAA ER-L values for sediment;
- EPA Ambient Water Quality Criteria for Aquatic Life;
- ORNL Wildlife Toxicology Benchmarks for Surficial Soils;
- Washington Sediment Management Standards; and
- ORNL Toxicological Benchmarks for Soil Invertebrates and Plants;

Because the Bayer facility is an active industrial facility and will likely remain so for the foreseeable future, screening-criteria based on industrial exposures will be employed for the site media.

Following completion of the Phase 2 investigation and Screening-level Risk Assessment, three groups of SWMUs will have been identified. Group A SWMUs will consist of units that require no further investigation and no further action. Because the sampling program in Phase 2 is targeted at the areas of highest contamination, if a SWMU passes the conservative risk screening for Phase 2, then it is reasonable to conclude with confidence that the SWMU poses no significant risk, and requires no corrective action. Groups B and C will consist of sites that may require some additional investigation and/or corrective action. Prior to finalizing the scope of sampling for Phase 3, the Phase 2 data for Group B SWMUs will be reviewed to determine whether data are sufficient to proceed directly to a detailed site-specific risk assessment. Group B SWMUs that are found to require additional characterization after the Phase 2 risk assessment, and all Group C SWMUs will be identified for inclusion in the Phase 3 investigation. Following completion of the Phase 3 investigation, a detailed site-specific risk assessment will be performed.

The risk assessment for the Group B SWMUs may proceed immediately or be put on hold until the Phase 3 investigations of the Group C units are completed. As indicated in Section 1.3, 30 SWMUs are being investigated in the RFI; therefore, the Bayer facility represents multiple sites. It would be inefficient and uninformative to conduct detailed baseline risk assessments of each SWMU independently because the SWMUs are not completely independent of each other in terms of

chemical presence, potential exposure, and potential risks. Therefore, it may make sense at the end of Phase 2 to group SWMUs for further investigation under Phase 3. Similarly, it may make sense to group units for the detailed Site-specific Risk Assessment. The individual units will be evaluated to determine if grouping makes sense on the basis of commonalities in exposure potential, constituents of interest, location, and potential corrective action:

2.2.3.2 Technical Approach

This section of the RFI work plan describes in detail the technical approach to be employed in conducting the Site-specific Risk Assessment(s) of the Groups B and C SWMUs (i.e., those that are not eliminated on the basis of the screening-level risk assessment) and sitewide groundwater.

The Baseline Risk Assessment of the facility SWMUs will consist of both a human health risk assessment and an ecological evaluation. Detailed Site-specific Risk Assessments will be conducted for all SWMUs not screened out following Phase 2 of the RFI. The SWMUs that require a site-specific risk assessment may be grouped together into one or more "risk assessment areas" for the human health risk assessment. For the ecological evaluation, the entire facility will be evaluated as a whole. The following sections describe the planned technical approaches to the site-specific human health risk assessments and ecological evaluation. The Baseline Risk Assessment for groundwater will assume that the current pumping and hydraulic containment represent baseline conditions.

Human Health Risk Assessment

The human health risk assessments to be conducted for Groups B and C SWMUs, grouped as appropriate, and for sitewide groundwater (if complete exposure pathways are identified for this medium) at the Bayer facility will be conducted in accordance with EPA's *Risk Assessment Guidance for Superfund* (RAGS) (EPA, 1989a) and supplemental EPA risk assessment guidance issued since 1989 (EPA, 1991a; 1992a). As such, the human health risk assessment for each group of SWMUs will consist of the following steps:

- Identification of Chemicals of Potential Concern
- Exposure Assessment
- Toxicity Assessment

■ Risk Characterization and Uncertainty Analysis

Identification of Chemicals of Potential Concern. The first step of the risk assessment involves identifying those chemicals that have the greatest potential for producing adverse human health effects following exposure at the facility. Chemicals of potential concern under an RFI will be identified through comparison with defined health and environmental criteria (EPA, 1989a). As a first screening step for exclusion of chemicals, the maximum detected concentration of each chemical at each SWMU or group of SWMUs will be compared to the EPA Region III Risk-Based Concentration (RBCs) (EPA Region III, 1995). Chemicals detected in soils will be compared to Region III RBCs for industrial soils as the facility is an active industrial facility and will likely remain so for the foreseeable future. Although groundwater beneath the facility is currently being extracted and treated as an interim measure and, as a result, there are no complete exposure pathways to chemically-affected groundwater, there are residential and municipal wells upgradient of the facility. Therefore, concentrations of chemicals in groundwater will be compared to Region III RBCs for drinking water. Chemicals with maxima below the RBCs will not be considered further in the risk assessment process. If chemicals for which RBCs have not been derived are detected at a SWMU, comparison criteria will be derived following the procedures identified in other EPA risk assessment guidance (EPA, 1989a; 1991b).

While comparison with health criteria will be used as the primary means of identifying chemicals of potential concern at the Bayer facility, additional considerations, as recommended by the EPA (1989a), will also be taken into consideration. These factors include environmental fate and transport properties, laboratory contamination, natural and anthropogenic background concentrations, and the likelihood that a chemical is site-originated. In addition, any detected chemicals of low inherent toxicity (i.e., essential nutrients) will be eliminated as chemicals of potential concern.

Exposure Assessment. The exposure assessment estimates the likely magnitude of current or future contact with chemicals of potential concern by identifying actual or potential routes of exposure, characterizing the exposed populations, and determining the extent of human exposure to the chemicals.

The principal elements of exposure assessment involve the identification of potential receptors and exposure pathways, evaluation of the impact of fate and transport processes on the chemicals of

concern, identification of reasonable exposure scenarios, estimation of exposure point concentrations and quantification of exposure doses. Pathways of exposure are the means through which an individual may come into contact with chemicals of concern. Exposure pathways are determined by environmental conditions (e.g., climatic conditions), potential for chemicals to move from one medium (e.g., soil, air) to another, and by the general characteristics of the potentially exposed population. Although several potential pathways may exist, only a few may result in significant chemical exposure. The risk assessment, in accordance with RAGS, will quantitatively evaluate only complete exposure pathways. For a pathway to be complete, each of the following elements must exist (EPA, 1989a):

- A source and mechanism for constituent release;
- An environmental transport medium (e.g., air, water, soil);
- A point of potential contact with the medium; and
- An exposure route at the contact point (e.g., inhalation, ingestion, dermal contact).

The exposure assessment for the Bayer facility will involve a comprehensive evaluation of potential receptors and complete exposure pathways appropriate for inclusion in the risk assessment. Specific exposure parameter values to be incorporated into the risk calculations will be determined after decisions are made regarding the receptors and exposure pathways to be evaluated. Factors will be derived from the appropriate EPA guidance documents (1989a, 1989b, 1991a). Chemical degradation and bioavailability factors will be included in the dose calculations. Comprehensive tables of exposure factors and the resulting calculated doses will be prepared.

A list of potential human receptors at the Bayer facility includes current and future plant workers and nearby off-site residents. The exposure assessment will identify the specific exposure pathways that are appropriate for each potential receptor. Likely exposure pathways for quantitative analysis at some SWMUs include:

- incidental ingestion of chemicals in exposed surface soil;
- dermal contact with chemicals in exposed surface soil;
- inhalation of volatile chemicals from soil (if volatiles are present in surface or subsurface soil);

- inhalation of chemicals in airborne particulates mobilized from surface soil through wind erosion (only applicable for areas with no ground cover) and/or mechanical disturbances; and
- inhalation of chemicals in airborne particulates mobilized from subsurface soil during digging activities (where applicable).

Modeling may be required to support the evaluation of particular exposure pathways (e.g., inhalation of volatiles or particulates in air). If this is the case, EPA-approved models (e.g., VLEACH, Wind Erosion Rapid Assessment Methodology) will be used to derive exposure point concentrations in the applicable medium.

In general, current exposure pathways at most SWMUs include only pathways of contact with surface soils. The risk assessment of individual units or groups of units will include two considerations of subsurface soils. First, because the plant is active, it is possible that future exposure to subsurface soils could occur to on-site workers during short-term digging or construction-type activities. The exposure of a short-term construction worker to subsurface soils will be evaluated at those locations where future construction is feasible according to plant personnel. The second consideration for subsurface soils is the potential for leaching of chemicals from subsurface soils to groundwater. The RFI will consider the likelihood that subsurface soils at specific SWMUs could be a continuing source of chemical releases to groundwater. This evaluation will be conducted to focus future remedial actions by identifying SWMUs that are potentially releasing chemicals to the groundwater. SWMUs that do not pose unacceptable risk to future workers or for leaching to groundwater would not be expected to require any mitigation measures.

Groundwater at the Bayer facility is being addressed on a sitewide basis in this RFI. Therefore, separate SWMU-specific groundwater risk assessments are not appropriate. A quantitative risk assessment of groundwater would only be conducted for complete exposure pathways. At this time, no complete exposure pathways to groundwater have been identified. Groundwater from the production wells is used to clean off the RCRA pad, as non-contact cooling water, and scrubber water and is then discharged to the wastewater treatment system. Water for all contact and potable uses at the plant is obtained from a public water supply. There is no opportunity for off-site migration of the groundwater due to the on-site hydraulic containment. Therefore, a qualitative evaluation of groundwater is anticipated.

Toxicity Assessment. Toxicity assessment involves the characterization of the relationship between the dose of a chemical and the potential for adverse health effects (response). EPA-derived toxicity criteria will be identified that address both potential carcinogenic and noncarcinogenic adverse health effects. The most recent reference doses (RfDs) for noncarcinogens and cancer slope factors (CSFs) for the putative carcinogens will be identified. If chemicals evaluated as carcinogens also present the potential for noncarcinogenic health effects of concern, both potential endpoints will be evaluated. The primary source for toxicity criteria will be EPA's Integrated Risk Information System (IRIS). EPA's Health Effects Assessment Summary Tables (HEAST) will serve as a secondary source. Approved EPA toxicity criteria may not be available for all of the chemicals of concern. Provisional values from EPA's Environmental Criteria Assessment Office (ECAO) will be employed if available. The literature will be reviewed for the purposes of identifying surrogate criteria based on similarities in chemical structure. If a surrogate criterion is not available and the chemical is essential to the risk assessment, then EPA-approved methods will be employed to derive an alternative toxicity criterion.

Risk Characterization. The final step of the human health risk assessment process involves the synthesis of the toxicity and exposure assessments to arrive at qualitative and quantitative evaluations of potential health risks and hazards. Risk characterization is the description of the nature and magnitude of the potential occurrence of adverse health effects under a specific set of conditions. Data regarding each receptor, each chemical of potential concern, and each exposure pathway will be presented in tabular format. Potential noncarcinogenic health effects will be evaluated with regard to the specific target organ or mechanism of action of the chemical. Both the noncarcinogenic hazards and theoretical excess lifetime cancer risks associated with the estimated exposure will then be compared to regulatory criteria (EPA, 1989a, 1991c).

A key element of the risk characterization process is a discussion of the uncertainties associated with the various elements of the assessment. The conclusions of the risk characterization and the associated uncertainties can then provide the basis for the later identification of the most appropriate remedial action alternative, and serve as an input to the risk management decision process. Uncertainties in the risk characterization process will be discussed based on a knowledge of the uncertainties in exposure estimates, site characterization data, and chemical toxicity information. At this time a qualitative uncertainty analysis is proposed. However, Bayer may opt at a later point to conduct quantitative (stochastic) analyses of uncertainty to provide more realistic estimates of potential health risks.

Ecological Evaluation

The ecological evaluation will be conducted in accordance with the EPA's RAGS, Volume II, Environmental Evaluation Manual (EPA, 1989c), and Framework for Ecological Risk Assessment (EPA, 1992b). EPA Region III ecological risk assessment guidance (EPA Region III, Undated; EPA Region III, 1994) will also be employed as appropriate. Potential on-site terrestrial habitats and receptors will be identified during a qualitative on-site survey. In addition, information on terrestrial receptors will be collected from local, state, or federal agencies describing species found in area surveys. A database and literature search will be conducted to further identify potential species that might be found on-site. These species will be evaluated to identify behaviors affecting the extent and duration of potential contact with affected media. The chemicals detected in various areas of the plant will be evaluated to determine those chemicals of potential concern with regard to potential ecological effects.

After the primary chemicals of potential ecological concern have been identified, their potential toxicological effects on ecological receptors will be evaluated and summarized based on the available scientific literature. Types of ecotoxicological information to be evaluated include LC_{50} (lethal concentration for 50 percent of organisms) and EC_{50} (concentration associated with effects in 50 percent of organisms) values for terrestrial invertebrates potentially found in the area, no-observed-adverse-effect-levels (NOAELs), lowest-observed-adverse-effect-levels (LOAELs), laboratory and field-derived toxicity data, and available federal and state criteria and guidelines.

The collected information on species potentially present in areas of the Bayer facility will be compared with toxicity information for the chemicals present to derive an overall evaluation of the potential for adverse ecological effects due to chemical releases.

2.3 DATA NEEDS

The RFI data needs presented in this section were identified based on a conceptual understanding of site environmental conditions, which were summarized in the DOCC Report. Facility environmental conditions including facility history, waste disposal practices, site geology, site hydrogeology, groundwater quality (on a sitewide basis), surface water quality, soil quality (on a

SWMU by SWMU basis), and detailed SWMU descriptions are presented in Section 3 of the DOCC. Section 4 of the DOCC Report identifies RFI data gaps for soil and groundwater. The RFI data needs presented in this section are consistent with those identified in the DOCC; however, in response to EPAs concern over surface water and sediments, surface water and sediment sampling of the Ash Lagoon (SWMU 4) has been added to this plan. Additional sampling identified for the Ash Lagoon is presented in subsection 2.3.3.

2.3.1 Soils

Presence, absence, horizontal, and vertical extent of contamination in soils will be investigated on a SWMU by SWMU basis. As summarized in the DOCC Report, existing soil information has filled many of the RFI data needs; however, additional information is needed to fulfill RFI site characterization, risk assessment, and CMS data needs for all 30 SWMUs. VOCs, SVOCs and selected metals need to be tested for in SWMU soils to meet the site characterization data needs. These additional data will provide information needed to define the nature and extent of contamination potentially posing a risk to human health and the environment.

Risk assessment requires data to allow identification of potential chemicals of concern and evaluation of potential exposure pathways. The data collected for site characterization purposes will allow the identification of chemicals of potential concern. The data needed for modeling of potential exposure pathways includes physical data such as grain size distribution, hydrometer analysis and bulk density as well as total organic carbon (TOC) analysis.

The CMS requires various engineering data to evaluate potential corrective measures. Generally, CMS data needs include TOC, pH, moisture content, grain size distribution, paint filter test, Atterberg Limits, consolidation, and permeability. Table 2-2 provides a more detailed summary of the data needed to evaluate various soil remediation technologies.

2.3.2 Groundwater

As the result of historical pumping, co-mingling of contaminant plumes, and potential for plumes to have been cut off from their original source, groundwater will be investigated on a sitewide basis as opposed to a SWMU by SWMU basis. Existing information presented in the DOCC Report fulfills

TABLE 2-2

DATA NEEDS TO EVALUATE SOIL REMEDIATION TECHNOLOGIES

Soil Remediation Technology	Applicable to Chemicals	Evaluation Parameter	Rationale
Thermal Destruction - Low Temperature Thermal Extraction - Incineration	CS ₂ Organics PCBs	Grain Size Distribution	Used to evaluate pretreatment requirements for physical separation. Also, used as design parameter for feed system.
		BTU Value; % Ash; Flash Point	Used to evaluate implementability of thermal treatment and need for auxiliary fuel.
		Moisture Content	Used to evaluate handling and feeding of wastes and impacts process energy requirements.
		Metals	May impact air emissions.
		TOX	May attack refractory materials in incinerator and impact air emissions.
		Bulk Density	Used in evaluating quantity of material to be disposed.
Solvent Extraction/ Soil Washing	Metals Organics PCBs	TOC	Used to evaluate soil washing rinse cycles.
		Grain Size Distribution	Used to evaluate pretreatment requirements for physical separation.
		Cation Exchange Capacity	Used to evaluate process effectiveness and chemical recoverability.
		Moisture Content	Used to evaluate pretreatment requirements and process potential.
		Bulk Density	Useful in evaluating potential for in-situ treatment.
		Permeability	Used to evaluate process effectiveness.
		pH	Useful in developing washing fluid requirements.
Solidification - Stabilization - Vitrification	Metals Organics (<20% by volume)	TOC	High organic levels may interfere with bonding.
		TPH	May have detrimental effects on bonding.
		Metal Salts & Sulfates	May interfere with curing process and ultimately reduces product strength.
		Grain Size Distribution	Fine materials such as silts and clays interfere with setting and curing.
		Permeability	Used to evaluate process effectiveness.
		Moisture Content	Used to evaluate pretreatment requirements.
		Bulk Density	Useful in evaluating potential for in-situ treatment.
		TOX	High levels may retard setting. Halides easily leached.
		pH	Necessary to determine pre-treatment requirements for metals treatment.

TABLE 2-2 (Continued)

DATA NEEDS TO EVALUATE SOIL REMEDIATION TECHNOLOGIES

Soil Remediation Technology	Applicable to Chemicals	Evaluation Parameter	Rationale
Soil Vapor Extraction	Volatile Organics Some Semivolatile Organics	Permeability	Used to evaluate extraction rates and process potential and effectiveness.
		TOC	Used to evaluate chemical transport and ease of extraction.
		Moisture Content	High moisture content hinders air movement through soils.
		Bulk Density	Used in evaluating quantity of material to be disposed.
Thermally Enhanced Soil Vapor Extraction	Volatile Organics Semivolatile Organics	Permeability	Used to evaluate extraction rates and process potential and effectiveness.
		TOC	Used to evaluate chemical transport and ease of extraction.
		Moisture Content	High moisture content hinders air movement through soils.
		Bulk Density	Used in evaluating quantity of material to be disposed.
Biological Destruction - Bioslurry - Bioremediation	Organics Chlorinated Organics PCBs	Permeability	Used to evaluate potential for in-situ treatment.
		Moisture Content	Moisture content affects bacterial activity and oxygen availability.
		Metals	High levels of metals may inhibit biological degradation process.
		pH	pH affects microbial activity.
		Bulk Density	Used in evaluating quantity of material to be disposed.
Containment	All	Grain Size Distribution	Soil property need for evaluation of applicable containment facilities.
		Moisture Content	Soil property need for evaluation of applicable containment facilities.
		Specific Gravity	Soil property need for evaluation of applicable containment facilities.
		Atterberg Limits	Soil property need for evaluation of applicable containment facilities.
		Consolidation	Soil must be capable of supporting weight of containment facility (single or multi layer cap).
Landfilling	All	RCRA Characteristics ⁽¹⁾	Necessary to evaluate disposal options.
		Bulk Density	Used in evaluating quantity of material to be disposed.

(1) RCRA Characteristics include TCLP organics and metals, ignitability, corrosivity, and reactivity.

all RFI site characterization and risk assessment data needs in groundwater. However, additional data are needed for the CMS to allow evaluation of potential corrective measures technologies. Data needed to evaluate various groundwater corrective measures technologies are provided in Table 2-3. Bayer has already collected Total Dissolved Solids (TDS), TOC, nitrate, metals, and pH data as part of its ongoing routine monitoring. Additional CMS data needs include analysis of a limited number of groundwater samples for total suspended solids (TSS), biological oxygen demand (BOD), chemical oxygen demand (COD), nitrogen content (total nitrogen), and oil and grease. A substantial amount of metals data is available from historic groundwater monitoring; therefore, no additional RFI groundwater metals data will be obtained for the CMS.

2.3.3 Ash Lagoon Water and Sediment Sampling

Lagoon water and sediment samples will be collected from the Ash Lagoon (SWMU 4) as part of the RFI. The results will be evaluated for site characterization, risk assessment and CMS data needs. The lagoon water and sediment will be analyzed for VOCs, SVOCs, and selected metals. Additional CMS data needs for the lagoon water will include TOC, TSS, TDS, nitrate, total nitrogen, pH, BOD, COD, oil and grease. Lagoon sediments will be analyzed for VOCs, SVOCs, selected metals, grain size distribution, hydrometer analysis, bulk density, TOC, pH, moisture content, paint filter test, Atterberg Limits, consolidation, and permeability.

2.3.4 Surface Water and Sediment Data

Surface water and sediment (other than that within SWMU 4-2, the Ash Lagoon) will not be evaluated in the RFI because sufficient information exists to warrant their exclusion. Existing data presented in Section 3.6.5 of the DOCC Report (ICF kaiser, 1995a) show that contamination has not been detected in previously collected surface water samples (other than that thought to be associated with blank contamination). Also, contaminants in the perched groundwater zone are believed to discharge primarily downward into the alluvial aquifer, where they are ultimately captured by existing Bayer recovery wells. Groundwater elevation maps indicate that pumping of the recovery wells is sufficient to induce flow from the river into the alluvial aquifer, thereby preventing any discharge of contaminated groundwater into adjacent surface water bodies. Surface water and sediments will be investigated only if the RFI finds that the facility's SWMUs may have affected surface water and sediment at levels that potentially present an unacceptable risk.

*Don't
want
to
sample
it.*

*Does not present risk
Samples that
data indicates
no contamination*

*above facility:
along → below to
decide!*

Still need to sample

all RFI site characterization and risk assessment data needs in groundwater. However, additional data are needed for the CMS to allow evaluation of potential corrective measures technologies. Data needed to evaluate various groundwater corrective measures technologies are provided in Table 2-3. Bayer has already collected Total Dissolved Solids (TDS), TOC, nitrate, metals, and pH data as part of its ongoing routine monitoring. Additional CMS data needs include analysis of a limited number of groundwater samples for total suspended solids (TSS), biological oxygen demand (BOD), chemical oxygen demand (COD), nitrogen content (total nitrogen), and oil and grease. A substantial amount of metals data is available from historic groundwater monitoring; therefore, no additional RFI groundwater metals data will be obtained for the CMS.

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Lagoon water and sediment samples will be collected from the Ash Lagoon (SWMU 4) as part of the RFI. The results will be evaluated for site characterization, risk assessment and CMS data needs. The lagoon water and sediment will be analyzed for VOCs, SVOCs, and selected metals. Additional CMS data needs for the lagoon water will include TOC, TSS, TDS, nitrate, total nitrogen, pH, BOD, COD, oil and grease. Lagoon sediments will be analyzed for VOCs, SVOCs, selected metals, grain size distribution, hydrometer analysis, bulk density, TOC, pH, moisture content, paint filter test, Atterberg Limits, consolidation, and permeability.

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Surface water and sediment (other than that within SWMU 4-2, the Ash Lagoon) will not be evaluated in the RFI because sufficient information exists to warrant their exclusion. Existing data presented in Section 3.6.5 of the DOCC Report (ICF kaiser, 1995a) show that contamination has not been detected in previously collected surface water samples (other than that thought to be associated with blank contamination). Also, contaminants in the perched groundwater zone are believed to discharge primarily downward into the alluvial aquifer, where they are ultimately captured by existing Bayer recovery wells. Groundwater elevation maps indicate that pumping of the recovery wells is sufficient to induce flow from the river into the alluvial aquifer, thereby preventing any discharge of contaminated groundwater into adjacent surface water bodies. Surface water and sediments will be investigated only if the RFI finds that the facility's SWMUs may have affected surface water and sediment at levels that potentially present an unacceptable risk.

southern half. Analytical data for the ash lagoon samples are included in Appendix J.

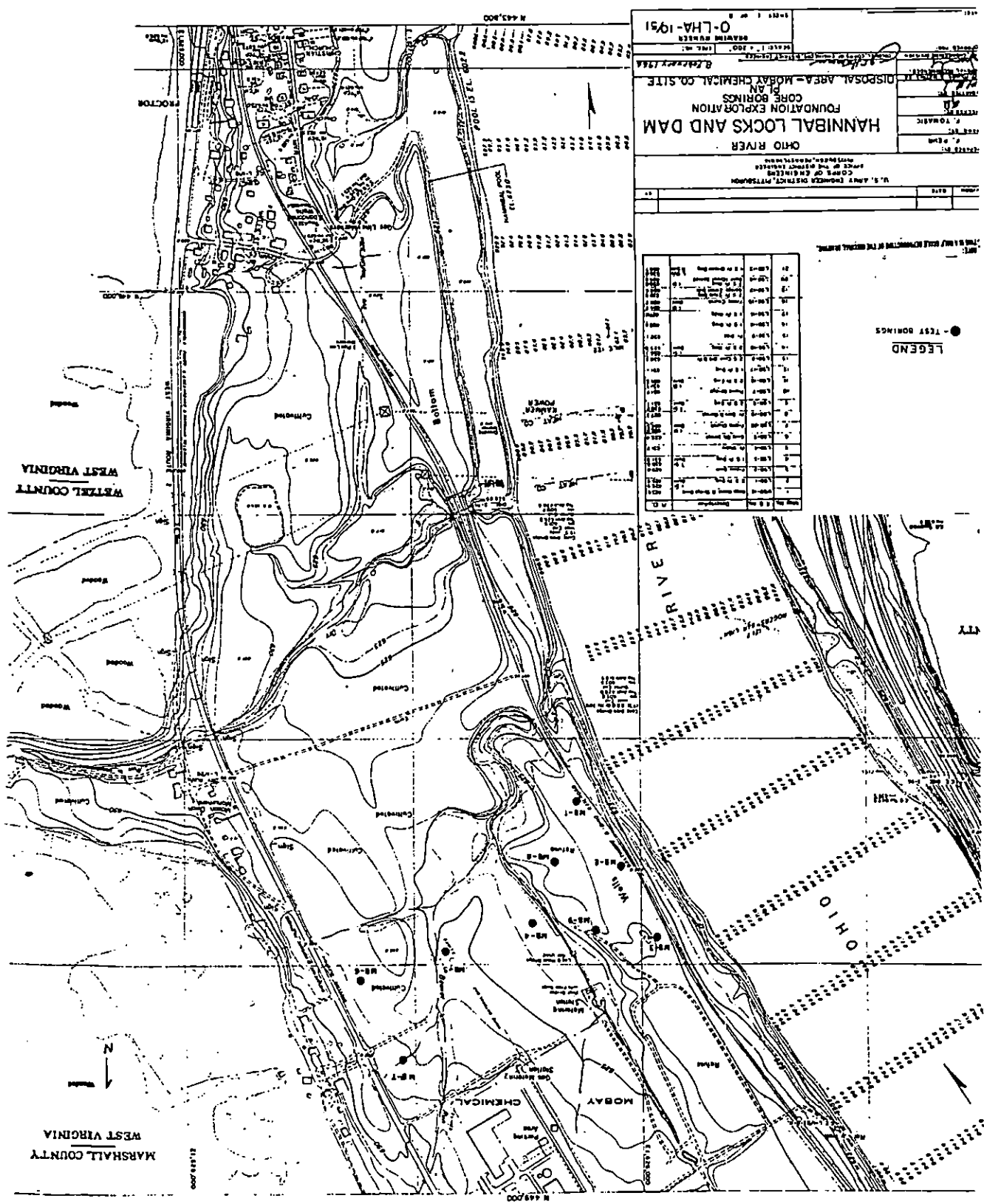
G. SURFACE WATER (BEAVER RUN)

The location of Beaver Run in 1966 is shown on a U.S. Army Corps of Engineers topographic map (Figure SW-15). Block 1 of the plant is visible at the top center of this figure, as is the then-undeveloped area which would later become the south landfill.

The development of this portion of the plant is detailed in the previous text discussions of the wastewater treatment area and the south landfill area. Figure SW-16 shows the location of the dikes (proposed in 1970) that would alter the original course of Beaver Run. The construction of these dikes and removal of borrow materials from the area determined the current configuration of the Beaver Run backwater when the river pool elevation rose after completion of the Hannibal Lock and Dam (1973).

Surface water from Beaver Run was sampled quarterly in 1986 at the locations proposed to U.S. EPA (Figure SW-26). The analytical results are summarized in Table SW-15.

FIGURE SM-13 Topography of the South
 End of the Plant (1966)
 Mobay Corporation
 New Martinsville, WV



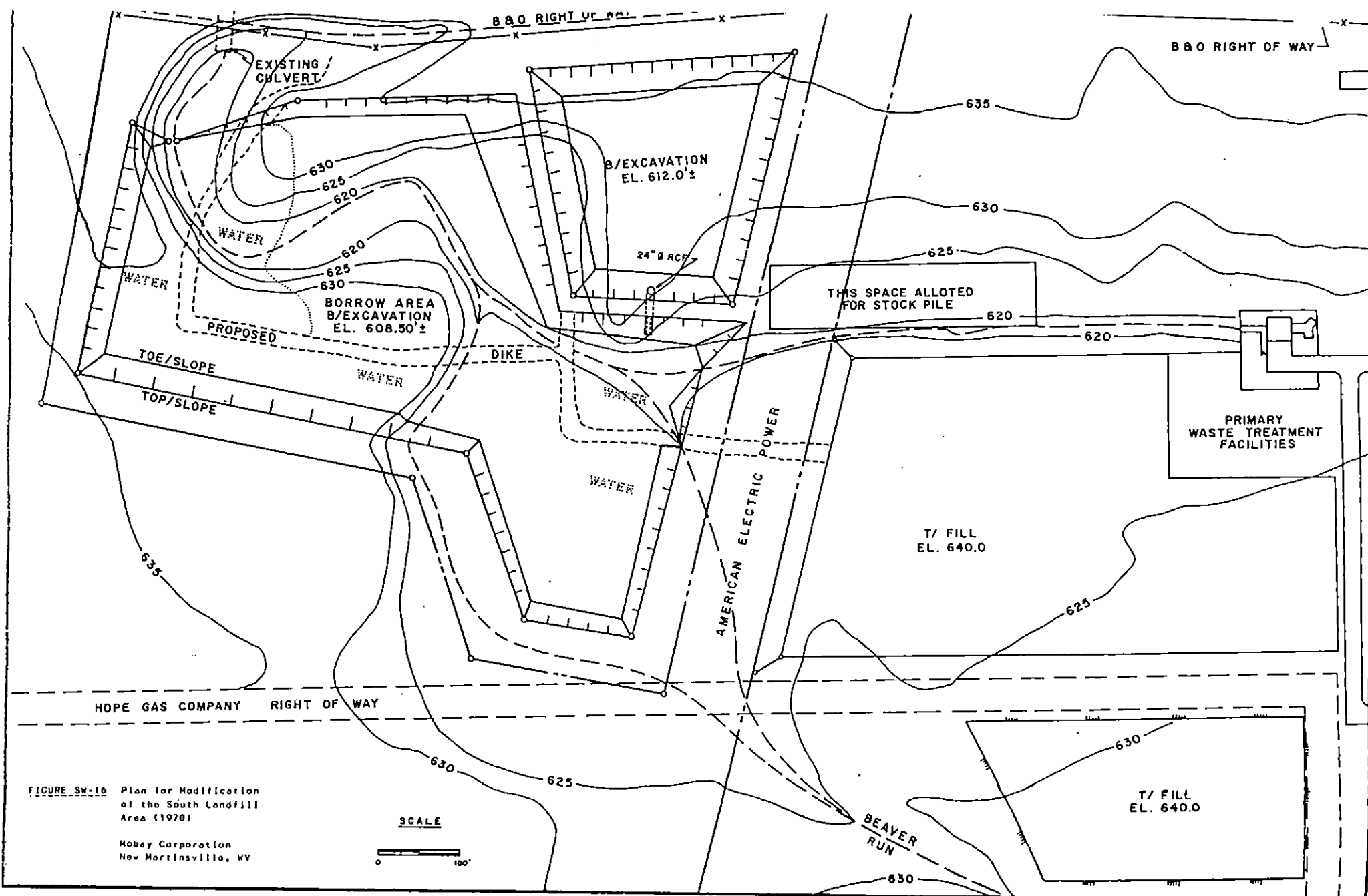
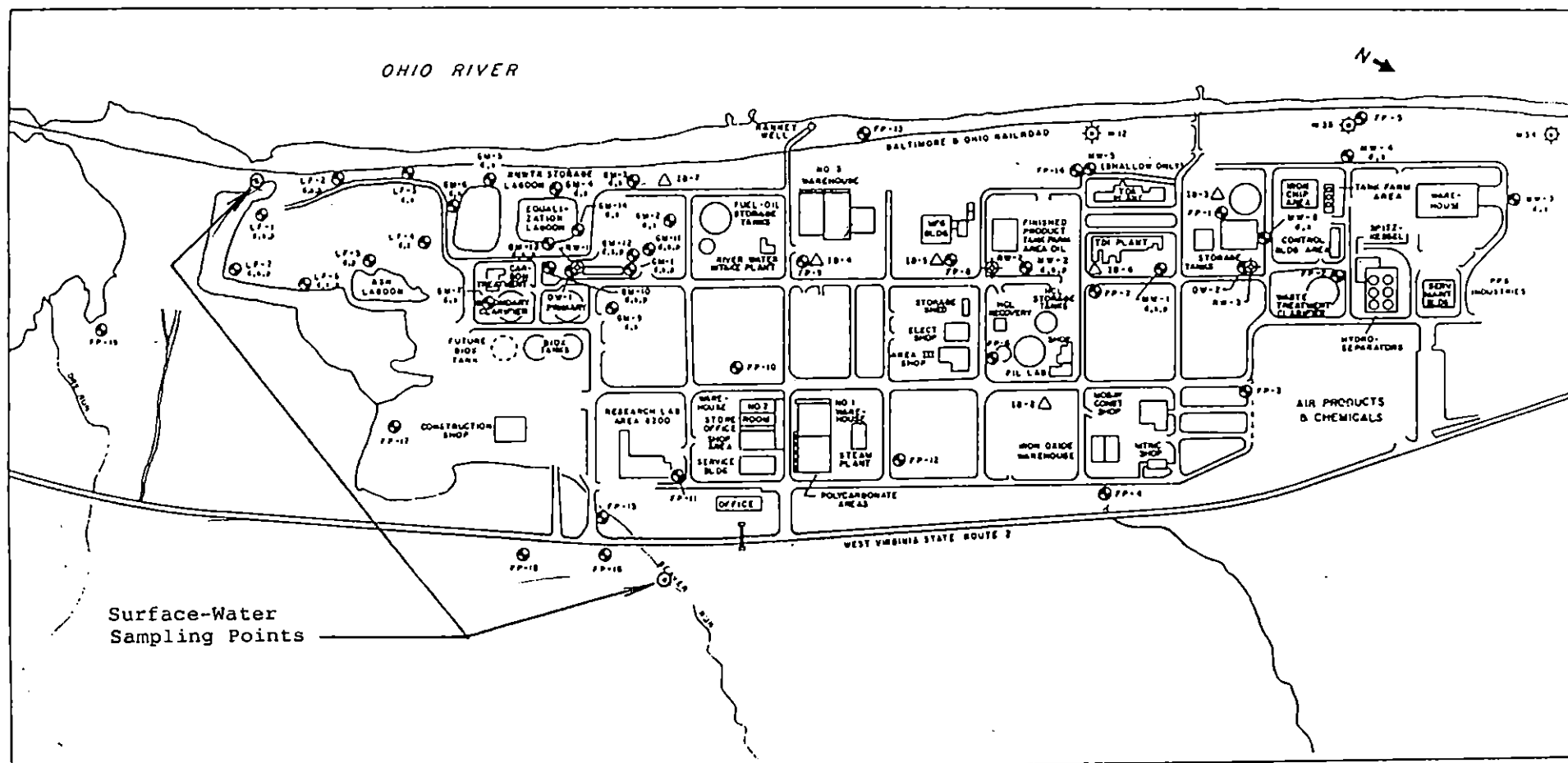


FIGURE SW-16 Plan for Modification of the South Landfill Area (1970)

Mobay Corporation
New Martinsville, WV

SCALE

0 100'



Surface-Water
Sampling Points

LEGEND

- FP-1 FULLY PENETRATING MONITOR WELL
- GW-1 RCRA AREA MONITOR WELL CLUSTER
- LF-1 LANDFILL AREA MONITOR WELL CLUSTER
- DEEP MONITOR WELL
- SHALLOW MONITOR WELL
- PERCHED ZONE MONITOR WELL
- GW-1 OBSERVATION WELL
- MW-2 PPG PUMPING WELL

LEGEND (continued)

- △ IB-3 INBOUND (ABANDONED WATER SUPPLY) WELL
- RW-1 RECOVERY WELL
- MW-1 MONITOR WELL CLUSTER
(G- and S- series, P- series if perched zone exists)
- Beaver Run Sampling Location

SCALE

0 200 400'

FIGURE SW-26

Surface Water Sampling Locations on Beaver Run
Mobay Corporation
New Martinsville, West Virginia

TABLE SW-15 SUMMARY OF ANALYTICAL RESULTS OF SURFACE-WATER SAMPLING

		First Quarter (1986)		Second Quarter (1986)		Third Quarter (1986)		Fourth Quarter (1986)	
		(Upstream)	(Downstream)	(Upstream)	(Downstream)	(Upstream)	(Downstream)	(Upstream)	(Downstream)
pH	S.U.	7.35	8.00	8.00	9.05	19.00	400	87.0	0.60
Temperature	Deg. C	13.00	13.00	16.00	330	66.0	0.55	16	84.0
Conductivity	umhos	490	275	288	84.0	0.50	36	87.0	102.0
Sulfates	ppm	66.0	92.0	80.0	0.80	15	100.0	106.0	10.0
Nitrates	ppm	1.30	1.80	0.80	28	140.0	122.0	6.0	286.0
Chlorides	ppm	25	14	11	77.0	171.0	9.0	212.0	---
Alkalinity (CaCO ₃)	ppm	72.0	72.0	93.0	93.4	4.0	306.0	---	---
Alkalinity (HCO ₃)	ppm	87.6	87.6	113.0	7.0	261.0	---	---	---
TOC	ppm	7.0	12.0	5.0	228.0	---	---	---	---
TDS	ppm	82.0	218.0	196.0	---	---	---	---	---
Barium	ppm	<.10	<.10	62	61	85	80	53	55
Calcium	ppm	87	93	---	---	---	---	---	---
Cadmium	ppm	<.01	<.01	0.03	0.01	0.01	0.01	0.01	<.01
Chromium	ppm	0.01	0.01	0.07	0.04	0.07	0.08	0.05	0.07
Iron	ppm	0.08	0.09	0.07	11	9	11	9	10
Magnesium	ppm	8	9	9	0.04	<1	<1	<.01	<1
Manganese	ppm	0.01	0.01	0.04	0.04	7.0	21.0	7	10
Sodium	ppm	6.0	11.0	8.0	15.0	0.002	0.002	0.001	0.001
Lead	ppm	<.001	<.001	<.001	<.001	<.01	<.01	0.01	0.02
Zinc	ppm	<.01	<.01	0.01	4.00	1.00	4.00	2	2
Potassium	ppm	2.00	3.00	1.00	<.001	---	---	---	---
Arsenic	ppm	---	---	<.001	<.001	---	---	---	---
Toluene	ppb	ND	ND	ND	ND	<100	ND	---	---
Chlorobenzene	ppb	ND	<10	ND	ND	ND	<10	ND	ND
Dichlorobenzene	ppb	ND	ND	ND	ND	ND	<10	ND	ND
Methylene dianiline	ppb	ND	ND	<10	<10	ND	ND	ND	ND
Bis-(2-ethylhexyl)-phthalate	ppb	ND	ND	<10	<10	<10	<10	ND	40

Note: No other volatile organic or base/neutral extractable compounds were detected.



TABLE SW-15 SUMMARY OF ANALYTICAL RESULTS OF SURFACE-WATER SAMPLES FROM BEAVER RUN

		First Quarter (1986)		Second Quarter (1986)		Third Quarter (1986)		Fourth Quarter (1986)	
		(Upstream)	(Downstream)	(Upstream)	(Downstream)	(Upstream)	(Downstream)	(Upstream)	(Downstream)
pH	S.U.	7.35	8.00	8.00	9.05	7.81	8.08	8.15	6.45
Temperature	Deg. C	13.00	13.00	16.00	---	19.00	19.00	7.50	---
Conductivity	umhos	490	275	288	330	400	460	360	370
Sulfates	ppm	66.0	92.0	80.0	84.0	66.0	87.0	87.0	174.0
Nitrates	ppm	1.30	1.80	0.80	0.80	0.50	0.55	0.60	1.50
Chlorides	ppm	25	14	11	28	15	36	16	20
Alkalinity (CaCO ₃)	ppm	72.0	72.0	93.0	77.0	140.0	100.0	87.0	84.0
Alkalinity (HCO ₃)	ppm	87.6	87.6	113.0	93.4	171.0	122.0	106.0	102.0
TOC	ppm	7.0	12.0	5.0	7.0	4.0	9.0	6.0	10.0
TDS	ppm	82.0	218.0	196.0	228.0	261.0	306.0	212.0	286.0
Barium	ppm	<.10	<.10	---	---	---	---	---	---
Calcium	ppm	87	93	62	61	85	80	53	55
Cadmium	ppm	<.01	<.01	---	---	---	---	---	---
Chromium	ppm	0.01	0.01	0.03	0.01	0.01	0.01	0.01	<.01
Iron	ppm	0.08	0.09	0.07	0.04	0.07	0.08	0.05	0.07
Magnesium	ppm	8	9	9	11	9	11	9	10
Manganese	ppm	0.01	0.01	0.04	0.04	<1	<1	<.01	<1
Sodium	ppm	6.0	11.0	8.0	15.0	7.0	21.0	7	10
Lead	ppm	<.001	<.001	<.001	<.001	0.002	0.002	0.001	0.001
Zinc	ppm	<.01	<.01	0.01	0.02	<.01	<.01	0.01	0.02
Potassium	ppm	2.00	3.00	1.00	4.00	1.00	4.00	2	2
Arsenic	ppm	---	---	<.001	<.001	---	---	---	---
Toluene	ppb	ND	ND	ND	ND	<100	ND	---	---
Chlorobenzene	ppb	ND	<10	ND	ND	ND	<10	ND	ND
Dichlorobenzene	ppb	ND	ND	ND	ND	ND	<10	ND	ND
Methylene dianiline	ppb	ND	ND	<10	<10	ND	ND	ND	ND
Bis-(2-ethylhexyl)-phthalate	ppb	ND	ND	<10	<10	<10	<10	ND	40

Note: No other volatile organic or base/neutral extractable compounds were detected.

During relatively wet periods, seeps have been observed along the southern perimeter of the south landfill. In order to document the quality of seep fluids, laboratory analyses for priority pollutant organics were performed during September 1986 by Mobay's Environmental Research Laboratory on a sample obtained from landfill seepage near the effluent flow meter in the south landfill. Results from this seep sampling and analysis are contained in Table SW-16.

TABLE SW-16. Results of Laboratory Analysis of Seepage from the South Landfill

<u>VOLATILES</u>	<u>CONCENTRATION (ppm)</u>
methylene chloride	ND
chloroform	ND
1,2-dichloroethane	ND
1,1,1-trichloroethane	ND
carbon tetrachloride	ND
trichloroethylene	ND
benezene	ND
tetrachloroethylene	ND
toluene	<0.01
chlorobenzene	ND
ethylbenzene	ND
xylene	ND
dichlorobenzene	ND
<u>BASE-NEUTRALS</u>	<u>CONCENTRATION (ppm)</u>
aniline	0.1
dichlorobenzene	0.01
o,p-toluidine	0.13
m-toluidine	ND
nitrobenzene	0.57
o-nitrotoluene	ND
m-nitrotoluene	ND
p-nitrotoluene	ND
toluenediamine	INT
2,6-dinitrotoluene	ND
2,4-dinitrotoluene	0.07
nitrotoluidine	0.01
methylenedianiline	ND
bis-(2-ethylhexyl)-phthalate ester	0.01

KEY: ND = Not Detected; INT = Interference

TABLE 2-3

DATA NEEDS TO EVALUATE GROUNDWATER REMEDIATION TECHNOLOGIES

Groundwater Remediation Technology	Applicable to Chemicals	Evaluation Parameter	Rationale
Carbon Adsorption	Organics	TOC	Used to evaluate organic loading on carbon and estimate carbon usage.
		TSS	Used to evaluate pre-treatment requirements.
		Metals	Used to evaluate pre-treatment requirements.
		pH	Important in determining metal solubilities which affects the process.
		Oil and Grease	Oil and grease may interfere with the adsorption process.
Ultraviolet Oxidation	Organics	TOC	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
		TSS	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
		Metals	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
		pH	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
Air/System	Stripping Volatile Organics NH_3	TSS	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
		Metals	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
		pH	Used to evaluate requirements for oxidant addition based on total organics in the groundwater.
		Nitrate, total nitrogen	Nitrate must be converted to ammonia in order to be stripped.
Chemical Precipitation/Coagulation/Sedimentation	Metals, suspended solids	TSS	Used to evaluate settling characteristics of groundwater and determine if flocculating agents needed.
		TDS	Used to evaluate settling characteristics of groundwater and determine if flocculating agents needed.
		pH	Necessary to determine metal solubilities and select appropriate precipitating agents.
Filtration	Suspended solids	TSS	Necessary to evaluate filtration requirements.

TABLE 2-3 (Continued)

DATA NEEDS TO EVALUATE GROUNDWATER REMEDIATION TECHNOLOGIES

Groundwater Remediation Technology	Applicable to Chemicals	Evaluation Parameter	Rationale
pH Adjustment	Metals, solids	pH	pH affects solubilities of metals.
Reverse Osmosis	Organics	pH	Used to evaluate pretreatment requirements.
	Metals	Iron, manganese	R.O. membranes are subject to fouling from iron and manganese salts.
		TSS	Used to evaluate pretreatment requirements. Solids may plug the membrane.
		Oil and grease	Oil and grease may interfere with the separation process.
Groundwater Extraction and Treatment	All	Hydraulic Conductivity	Necessary to conduct groundwater flow modelling to evaluate extraction options.
		Hydraulic Gradient	Necessary to conduct groundwater flow modelling to evaluate extraction options.
		TOC (soils)	Necessary for solute transport modeling.
		Porosity (soils)	Necessary for solute transport modeling.
		Bulk Density (soils)	Necessary for solute transport modeling.
Subsurface Barrier - Slurry Wall	All	pH	Groundwater pH will affect barrier permeability.
		Permeability (confining layer)	A low-permeability confining layer is necessary to key in the slurry wall.
Air Sparging	Volatile Organics		
Thermally Enhanced Air Sparging	Volatile and Semivolatile Organics	Effective Porosity, TOC	
Bioremediation	Volatile and Semivolatile Organics	BOD, DO, TSS, TDS, pH, TOC, COD	

2.3.5 Site Analyte List

Table 2-4 summarizes the various site-specific analytes that will be tested for during the RFI. The analytical list identified was developed based on an evaluation of plant processes, raw materials (chemicals) used, chemicals produced, and waste chemicals.

As indicated in the notes at the end of Table 2-4, soil samples will be analyzed for toluene-diisocyanate (TDI) if a colorimetric test conducted in the laboratory indicates TDI is present in the sample. The method (included in the QAPP Addendum in Appendix B) has a detection limit of approximately 1 ppm. All soil samples analyzed by the lab will undergo the colorimetric test for TDI. Also, a selected number of samples from TDI residue fill areas will be analyzed for 2,4- and 2,6-TDI regardless of the colorimetric test results. However, it is unlikely that TDI will be detected in the TDI residue fill or soil samples because TDI reacts rapidly with water to produce carbon dioxide gas and polyurea (plastic). The residue remaining after the reaction is considered insoluble and inert.

The 2,6-toluenediamine (2,6-TDA) isomer will be tested on a soil sample only if 2,4-TDA is detected in the sample. There is no need to test for 2,6-TDA if 2,4-TDA is not present since these isomers are produced together.

2.4 REPORTING AND DATA ANALYSIS

At the conclusion of each of Phases 1 and 2, a technical memorandum will be submitted to EPA that contains the appropriate background information, the purpose of the task(s), the procedures followed to complete the task(s), the results of the task(s), an evaluation of the data, and conclusions drawn from the data evaluation. Both technical memorandums will also contain details of the work proposed for the next phase.

In order to assist EPA in assimilating the large volume of data and to maintain the overall RFI schedule, Bayer and their consultant will also make a presentation of the investigation findings from each phase and the plans for the subsequent phase at EPA's offices. The presentation will include recommendations for those SWMUs that should; 1) be subjected to addition investigation, interim

TABLE 2-4

SITE ANALYTE LIST

Volatile Organic Compounds

1,1,1,2-Tetrachloroethane	3-Chloro-1-propene	Hexachlorobutadiene
1,1,1-Trichloroethane	4-Chlorotoluene	Iodomethane
1,1,2,2-Tetrachloroethane	Acetone	Isopropylbenzene
1,1,2-Trichloroethane	Acrolein	m- & p-Xylene
1,1-Dichloroethane	Acrylonitrile	Methyl ethyl ketone
1,1-Dichloroethene	Benzene	Methyl isobutyl ketone
1,1-Dichloropropene	Bromobenzene	Methylene chloride
1,2,3-Trichlorobenzene	Bromochloromethane	n-Butylbenzene
1,2,3-Trichloropropane	Bromodichloromethane	n-Propylbenzene
1,2,4-Trichlorobenzene	Bromoform	Naphthalene
1,2,4-Trimethylbenzene	Bromomethane	o-Xylene
1,2-Dibromo-3-Chloropropane	c-1,2-Dichloroethene	p-Isopropyltoluene
1,2-Dibromoethane	Carbon disulfide	sec-Butylbenzene
1,2-Dichlorobenzene	Carbon tetrachloride	Styrene
1,2-Dichloroethane	Chlorobenzene	t-1,2-Dichloroethene
1,2-Dichloropropane	Chloroethane	t-1,4-Dichloro-2-butene
1,3,5-Trimethylbenzene	Chloroform	tert-Butylbenzene
1,3-Dichlorobenzene	Chloromethane	Tetrachloroethene
1,3-Dichloropropane	cis-1,3-Dichloropropene	Toluene
1,4-Dichlorobenzene	Dibromochloromethane	trans-1,3-Dichloropropene
2,2-Dichloropropane	Dibromomethane	Trichloroethene
2-Chloroethylvinyl ether	Dichlorodifluoromethane	Trichlorofluoromethane
2-Chlorotoluene	Ethyl methacrylate	Vinyl acetate
2-Hexanone	Ethylbenzene	Vinyl chloride

Compare to

Metals

Antimony	Chromium	Nickel
Cadmium	Lead	

TABLE 2-4 (Continued)

SITE ANALYTE LIST

Semivolatile Organic Compounds

1,2,3-Trichlorobenzene	4-Bromophenylphenyl ether	Ethyl methane sulfonate
1,2,4,5-Tetrachlorobenzene	4-Chloro-m-cresol	Fluoranthene
1,2,4-Trichlorobenzene	4-Chlorophenylphenyl ether	Fluorene
1,2-Dichlorobenzene	4-Nitroaniline	Hexachlorobenzene
1,2-Diphenylhydrazine	4-Nitrophenol	Hexachlorobutadiene
1,3-Dichlorobenzene	5-Nitro-o-toluidine	Hexachlorocyclopentadiene
1,4-Dichlorobenzene	7,12-Dimethylbenz(a)anthracene	Hexachloroethane
1-Chloronaphthalene	Acenaphthene	Indeno(1,2,3-cd)pyrene
1-Methylnaphthalene	Acenaphthylene	Isophorone
1-Naphthylamine	Acetophenone	m- & p-Cresol
2,3,4,6-Tetrachlorophenol	Aniline	m-Nitrotoluene
2,3-Dichloroaniline	Anthracene	m-Toluidine
2,4,5-Trichlorophenol	Azobenzene	Methyl methane sulfonate
2,4,6-Trichlorophenol	Benzidine	N-Nitrosodibutylamine
2,4-Dichlorophenol	Benzo(a)anthracene	N-Nitrosodimethylamine
2,4-Dimethylphenol	Benzo(a)pyrene	N-Nitrosodiphenylamine
2,4-Dinitrophenol	Benzo(b)fluoranthene	N-Nitrosodipropylamine
2,4-Dinitrotoluene	Benzo(g,h,i)perylene	N-Nitrosopiperidine
2,4-Toluenediamine	Benzo(k)fluoranthene	Naphthalene
2,6-Dichlorophenol	Benzoic acid	Nitrobenzene
2,6-Dinitrotoluene	Benzyl alcohol	o- & p-Toluidine
2-Chloronaphthalene	Bis(2-chloroethoxy)methane	o-Cresol
2-Chlorophenol	Bis(2-chloroethyl) ether	o-Nitrotoluene
2-Methylnaphthalene	Bis(2-chloroisopropyl) ether	p-Chloroaniline
2-Naphthylamine	Bis(2-ethylhexyl) phthalate	p-Dimethylaminoazobenzene
2-Nitroaniline	Bisphenol A	p-Nitrotoluene
2-Nitrodiphenylamine	Butyl benzyl phthalate	Pentachlorobenzene
2-Nitrophenol	Chrysene	Pentachloronitrobenzene
2-Picoline	Cyclohexanone	Pentachlorophenol
3,3'-Dichlorobenzidine	Di-n-butyl phthalate	Phenacetin
3-Methylcholanthrene	Di-n-octyl phthalate	Phenanthrene
3-Nitroaniline	Dibenzo(a,h)anthracene	Phenol
4,4'-Methylenedianiline	Dibenzofuran	Pyrene
4,6-Dinitro-o-cresol	Diethyl phthalate	Pyridine
4-Aminobiphenyl	Dimethyl phthalate	Trimethylphosphate
4-Aminodiphenylamine	Diphenylamine	

- Notes:
- All samples will be subjected to a colorimetric screen for toluene-diisocyanate (TDI).
 - 2,4-TDI and 2,6-TDI will be analyzed for if the screening result shows TDI is present in the sample.
 - 2,6-Toluenediamine (TDA) will be analyzed for if 2,4-TDA is detected in the sample.

action, or remedial action, 2) be subjected to additional data evaluation or risk assessment, or 3) be eliminated from further investigation or action. After the presentation and EPA's review and approval of the technical memorandum at the end of each phase, Bayer will initiate plans to implement the subsequent phase of work. The overall RFI schedule is critically dependent upon timely EPA review and approval of the reports submitted at the end of Phases 1 and 2. At the conclusion of Phase 3, the final RFI report will be prepared and submitted to EPA.

2.4.1 Phase 1 - Site Reconnaissance and Preliminary Source Evaluation

Data reporting for Phase 1 will consist of a technical memorandum containing tables and maps illustrating the Phase 1 findings, an interpretation of the findings, and recommendations for Phase 2. Phase 1 data will be evaluated to allow focused data collection in subsequent RFI tasks. The Phase 1 data will be compiled and presented as described in the following sections.

2.4.1.1 Task 1 - Historic Aerial Photograph/Plant Drawing Review and Site Survey

The primary product of the historic photograph/plant drawing review portion of Task 1 will be maps confirming the historic location of the 30 SWMUs, and the maximum probable historic extent of fill areas. The primary product of the site survey portion of Task 1 will be data needed to support the ecological risk assessment. The site survey data summary will include a tabulation of identified on-site terrestrial habitats and receptors and maps illustrating their location. Also, plan view maps illustrating surface conditions (i.e. paved, asphalt, bare ground, vegetated, etc.) in the vicinity of the 30 SWMUs will be produced.

2.4.1.2 Task 2 - Geophysical Surveys

RFI geophysical work will include both Electromagnetic (EM) and Ground Penetrating Radar (GPR) surveys. Initially, test surveys will be performed to evaluate the effectiveness of these methods prior to implementing the entire surveys. If the test surveys indicate the methods are providing satisfactory data, the entire surveys will be completed. EM survey data will be used to produce both in-phase and quadrature-phase shallow subsurface electrical conductivity maps of selected fill areas. The conductivity maps will be evaluated to confirm fill area boundaries and identify anomalous locations within the fill. The EM method is particularly useful for detecting and locating buried metallic

objects. GPR survey data will be used to produce radar profiles of infilled ditches and neutralization basins at the facility. The radar profiles will be interpreted to confirm the location, boundaries, and depth of the infilled ditches and neutralization basins. The interpreted locations and boundaries of infilled ditches and neutralization basins will be placed on a plan view map.

2.4.1.3 Task 3 - Soil Gas Survey

The primary product of RFI Task 3 will be isoconcentration maps illustrating the soil gas survey results. The maps will illustrate the concentrations of selected site-specific VOCs of interest at two different depths in the vadose zone for several of the RFI SWMUs. The distribution and location of VOCs in soil gas will be evaluated to provide information on the source location and media (i.e. local source in the vadose zone or volatilization from groundwater). The isoconcentration maps will be assessed to provide an initial indication on the nature and extent of contamination in the vadose zone.

2.4.1.4 Task 4 - CMS Groundwater Sample Collection

The primary product of RFI Task 4 will be a table summarizing the results of groundwater sample collection and analyses performed on 27 groundwater wells. The groundwater analytical data produced during the RFI are intended for potential future use in the CMS.

2.4.2 Phase 2 - Confirmatory Sampling/Initial Assessment of Nature and Extent

Data reporting for Phase 2 will consist of a technical memorandum containing tables and maps illustrating the investigation data, an interpretation of the findings, and recommendations for the next phase of work. Phase 2 analytical data will be subjected to a screening level risk assessment to provide initial data on nature and extent of contamination posing potential risks to human health and the environment, and to determine which SWMUs (or SWMU groups) should proceed to interim actions and/or Phase 3 of the RFI. Data needed to support the CMS will also be collected during Phase 2. Data collected during Phase 2 will be compiled and presented as described in the following sections.

2.4.2.1 Task 5 - Confirmatory Test Borings and Soil Sample Collection

Task 5 reporting will include boring logs, maps, tables, and figures displaying geologic and soil analytical data. The geologic data collected from each boring location will be presented on a log that will detail lithology, soil classification, and field geotechnical (i.e. standard penetration test) results. Geologic cross-sections through each SWMU will be generated that display the various subsurface soil/lithology horizons identified in subsurface borings. Tables of chemical analytical and geotechnical data will be created to summarize the results. Analytical data will also be displayed on plan view maps to illustrate areas affected by chemicals at concentrations of potential concern.

2.4.2.2 Task 6 - Concrete Sampling

The primary product for Task 6 will be tables summarizing the results of chemical analyses performed on concrete chip samples. In addition, the condition of the concrete and any visual observations made during concrete sampling (i.e. stains) will be summarized and reported.

2.4.2.3 Task 7 - Ash Lagoon Sample Collection

The primary product for Task 7 will be a summary table and plan view map displaying the chemical data for water and sediment collected from the Ash Lagoon (SWMU 4). The sediment samples will undergo visual classification. Any observation of visual contamination or odor in the water or sediments will be summarized and reported.

2.4.3 Phase 3 - Nature and Extent Investigation

After the completion of Phase 3 data collection and analysis, the RFI report will be generated that incorporates the findings of all three phases of the RFI. For those SWMUs that were not eliminated from further action after the Phase 2 screening-level risk assessment, a detailed risk assessment will be performed using data from Phases 2 and 3. Those SWMUs that are found to have acceptable risk will be recommended for no further action and those SWMUs that show unacceptable risk will be recommended for inclusion in the CMS. The results of the sitewide groundwater risk assessment will also be included in the final RFI report. Groundwater will be recommended for inclusion in the CMS if the risk assessment shows unacceptable risks associated with this medium.

2.4.3.1 Task 8 - Surface and Subsurface Sample Collection

The primary product for Task 8 will be geologic boring logs, and an update of tables and figures generated after Phase 2, Tasks 5, 6, and 7. This will include updating tables with new geotechnical and chemical analytical data as well as revising plan view maps and geologic cross-sections.

3.0 FIELD SAMPLING PLAN

The purpose of the Field Sampling Plan (FSP) is to provide the information and procedures necessary to perform the field investigation portion of the RFI. The following subsections provide descriptions of the field activities that will be performed and figures illustrating where data will be collected.

3.1 GENERAL FIELD PROCEDURES

The types of work covered in this FSP are listed in Table 3-1. Sample media include soil gas, surface and subsurface soil, groundwater, lagoon water, and lagoon sediment. The specific field procedures required to collect samples of the various media are described in specific subsections of this FSP.

3.1.1 Identifying and Surveying Sampling Locations

Prior to any intrusive work, sample locations will be identified in the field. Stakes or pin flags will be placed at each sample location where pavement is absent and paint will be used to mark sample locations on paved surfaces. After the locations have been marked, they will be inspected by members of the Bayer facility engineering department, and a Bayer digging/excavation permit will be issued. Any off-plant locations of intrusive work will be cleared with local utility companies. If a sample location is too close to a utility line, the location will be moved a minimal distance from the planned location to an area that is clear of utilities. After utility clearance has been granted, intrusive work may proceed at the sample location(s). Under no circumstances will a location be moved without the approval of the Bayer engineers or local utility officials.

All soil sample locations and selected EM, GPR, and soil gas survey locations will be located by a licensed professional surveyor both horizontally and vertically to ± 0.1 feet. Unsurveyed EM, GPR, and soil gas data collection points will be located to an accuracy of ± 0.5 feet by measuring distances from the surveyed points using a measuring wheel or steel tape.

TABLE 3-1

FIELD SAMPLING ACTIVITIES AND OBJECTIVES⁽¹⁾

Phase and Task Number	Field Sampling Activity	Objective of Activity
Phase 1 Task 1	Historical Aerial Photo/Drawing Review and Site Survey	Historical aerial photos/drawings will be used to confirm the limits of SWMUs. Site survey will be done to identify terrestrial habitats/receptors and surface conditions (i.e., paved, gravel, vegetated, etc.) for the risk assessment.
Phase 1 Task 2	Geophysical Surveys <ul style="list-style-type: none"> ▪ Ground Penetrating Radar Survey ▪ Electromagnetic Survey 	Survey information will be used to identify lateral variations in fill materials, locate buried metallic objects, and to locate the infilled ditch and feeder ditch boundaries.
Phase 1 Task 3	Soil Gas Surveys	Soil gas surveys will be used to delineate the vertical and horizontal distribution of contamination resulting from volatile organic compounds in the vadose zone or groundwater.
Phase 1 Task 4	CMS Groundwater Sampling	Data will potentially be used to evaluate corrective measure alternatives for groundwater in the CMS.
Phase 2 Task 5	Confirmatory Test Borings and Soil Sample Collection	Test borings/soil samplings will be used to define the nature and extent of contamination; analyses of chemical parameters will confirm the presence or absence of contamination in suspected areas of concern. The investigation will also provide data necessary to perform the screening level risk assessment.
Phase 2 Task 6	Concrete Sample Collection	Concrete samples will be collected to define the nature and extent of contamination present in concrete. The investigation will also provide information to perform risk assessment.
Phase 2 Task 7	Lagoon Water/Sediment Sample Collection	Investigation will provide information of nature and extent of contamination present in the lagoon. Water and sediment investigation will also provide data needed to perform the human health and ecological risk assessment.
Phase 3 Task 8	Surface and Subsurface Sample Collection	Investigation will assess vertical and horizontal extent of contamination at SWMUs requiring additional site characterization, risk assessment and corrective measures study.

(1) Refer to Figure 2-1 for a graphical representation of the Phases and Tasks.

3.1.2 Sampling Equipment and Procedures

Sampling equipment and procedures to be used during this RFI will be in accordance with the requirements set forth in the QAPP (ICF Kaiser, 1995b) and the QAPP Addendum (Appendix B-1). Table 3-2 provides a cross-reference list identifying where field procedures for tasks described in this section of the work plan are located in the QAPP or the QAPP Addendum. Equipment and procedures are discussed in general terms in the following subsections.

3.1.3 Decontamination of Personnel and Equipment

Personnel and equipment will be decontaminated during RFI sampling to protect field personnel, prevent cross-contamination of samples, and prevent the spread of potential contamination within or outside of the Bayer facility. Personnel will be decontaminated as specified in the Health and Safety Plan (HASP) (Appendix A) before leaving the work area for breaks or at the end of the day. Equipment decontamination will be in accordance with the procedures in the QAPP.

At the end of each day, all decontamination water will be contained in either 55-gallon drums or a polyethylene tank. All decontamination water container(s) will be labeled showing the date filled and source of the water. The container(s) will be located or staged on-site in an appropriate area for later sampling and proper disposition by Bayer.

3.1.4 Field Quality Control Samples

Trip blanks, equipment rinsate blanks, field ambient blanks, field duplicates, and matrix spike/matrix spike duplicates, as described below, will be collected to assess field quality control. The field sample identification plan for field quality control samples is outlined in Section 10 of the QAPP.

3.1.4.1 Trip Blanks

Trip blanks are used to evaluate organic contamination that may be introduced into the samples during shipment. One trip blank will consist of two 40-milliliter vials of reagent grade American Society for Testing and Materials (ASTM) Type II water (organic free deionized water). These vials will be placed in each shipping container with samples for analysis of volatile organic compounds

TABLE 3-2

FIELD ACTIVITY/QAPP CROSS-REFERENCE TABLE

Field Activity	QAPP Section
Surface Soil Sampling	5.1
Subsurface Soil Sampling	5.2
Groundwater Sampling	5.3
Concrete Sample Collection	Addendum (see Work Plan Appendix B-1)
Electromagnetic Surveys	Addendum (see Work Plan Appendix B-1)
Lagoon Water and Sediment Sample Collection	Addendum (see Work Plan Appendix B-1)
Ground Penetrating Radar (GPR) Survey	5.7
Soil Gas Surveys	5.9
Field Filtration of Samples	5.10
Field Measurements	5.11
Waste Material Handling	5.13
Decontamination Procedures	5.14
Sample Storage, Handling, and Shipment	5.15
Sample Custody - Field Documentation	6.1
Calibration Procedures and Frequency - Field Documentation	7.1
Internal Quality Control Procedures	10.0
Performance and System Audits - Field	11.1
Corrective Action Procedures - Field	14.1

(VOCs). These vials will then be analyzed for VOCs according to the methods described in the QAPP.

3.1.4.2 Equipment Rinsate Blanks

Rinsate blanks are used to evaluate the equipment decontamination process. After decontamination, the sampling equipment is rinsed a final time with reagent grade ASTM Type II water. The rinsate is collected and analyzed for the contaminants of concern. Rinsate blanks will be collected at a frequency of one per group of 20 or fewer investigative samples collected.

3.1.4.3 Field Ambient Blanks

Field ambient blanks are used to evaluate contamination that may be introduced to the samples from the ambient work area. They are made by pouring reagent grade ASTM Type II water directly into sample containers in the work area where sampling is being conducted. One field blank will be collected for every group of 20 samples per media and analyzed for contaminants of concern specific to the work area.

3.1.4.4 Field Duplicates

Field duplicates are prepared to evaluate sample location and sampling technique reproducibility. Although true duplicate samples are not possible for soil because this medium is not homogeneous, thorough mixing will help make a more homogeneous sample. The portion of any samples that will undergo VOCs analysis will be collected prior to mixing to avoid loss of volatiles. Duplicates will be collected for all sample types and analyzed for the contaminants of concern. Field duplicates will be collected at a frequency of one per group of 20 or fewer investigative samples collected by media.

3.1.4.5 Matrix Spike/Matrix Spike Duplicate

In general, matrix spike/matrix spike duplicates are collected in the same manner as field duplicates. Matrix spike and matrix spike duplicates are collected, where feasible, at sample locations with known contaminants or at locations with an unusual sample matrix (e.g., soil with high organic content). This practice will provide usable spike recovery information, giving an indication of positive or negative

effects from the sample matrix. Matrix spike/matrix spike duplicates are prepared to evaluate the effects of the sample matrix on the laboratory analytical results. Matrix spike/matrix spike duplicates will be collected at a frequency of one per group of 20 or fewer investigative samples collected.

3.2 PHASE 1 SITE RECONNAISSANCE AND PRELIMINARY SOURCE EVALUATION

3.2.1 RFI Task 1 - Historic Aerial Photograph/Plant Drawing Review and Site Survey

All 30 RFI SWMUs will be evaluated under RFI Task 1. Review of aerial photographs of the facility and plant construction drawings will be conducted with the objective of confirming the limits of fill areas and pinpointing the location of SWMUs that are no longer active (i.e. infilled wastewater ditch). The results of the photograph/drawing review will be field verified. The purpose of the site survey portion of RFI task 1 is to provide information needed for the human health and ecological risk assessment. During this survey, field personnel will map surface conditions (i.e. pavement, bare ground, gravel, vegetated, etc.) within and surrounding each SWMU. In addition, a description of terrestrial habitat and potential receptors will be recorded for use in the ecological risk assessment. The results of RFI task 1 will be used to refine sample locations for subsequent RFI tasks.

3.2.2 RFI Task 2 - Geophysical Surveys

Two geophysical methods, Electromagnetics (EM) and Ground Penetrating Radar (GPR) will be used in RFI Task 2. Prior to initiating the entire geophysical surveys, test surveys will be performed to ensure these methods will provide useful data.

3.2.2.1 Electromagnetic (EM) Surveys

The objectives of the EM surveys are to 1) confirm the horizontal limits of selected fill areas included in the RFI, and 2) identify any conductivity anomalies within the fill areas.

Overview

EM surveys are commonly used as reconnaissance tools to evaluate lateral or vertical changes in subsurface materials. Electrical conductivity is a function of the type of soil and rock (or waste material), its porosity and permeability, and the fluids filling the pore space. Anomalous readings of subsurface conductivity are used to map subsurface features. This method is highly amenable to mapping boundaries of fill areas and detecting buried metal objects or anomalous areas within landfills.

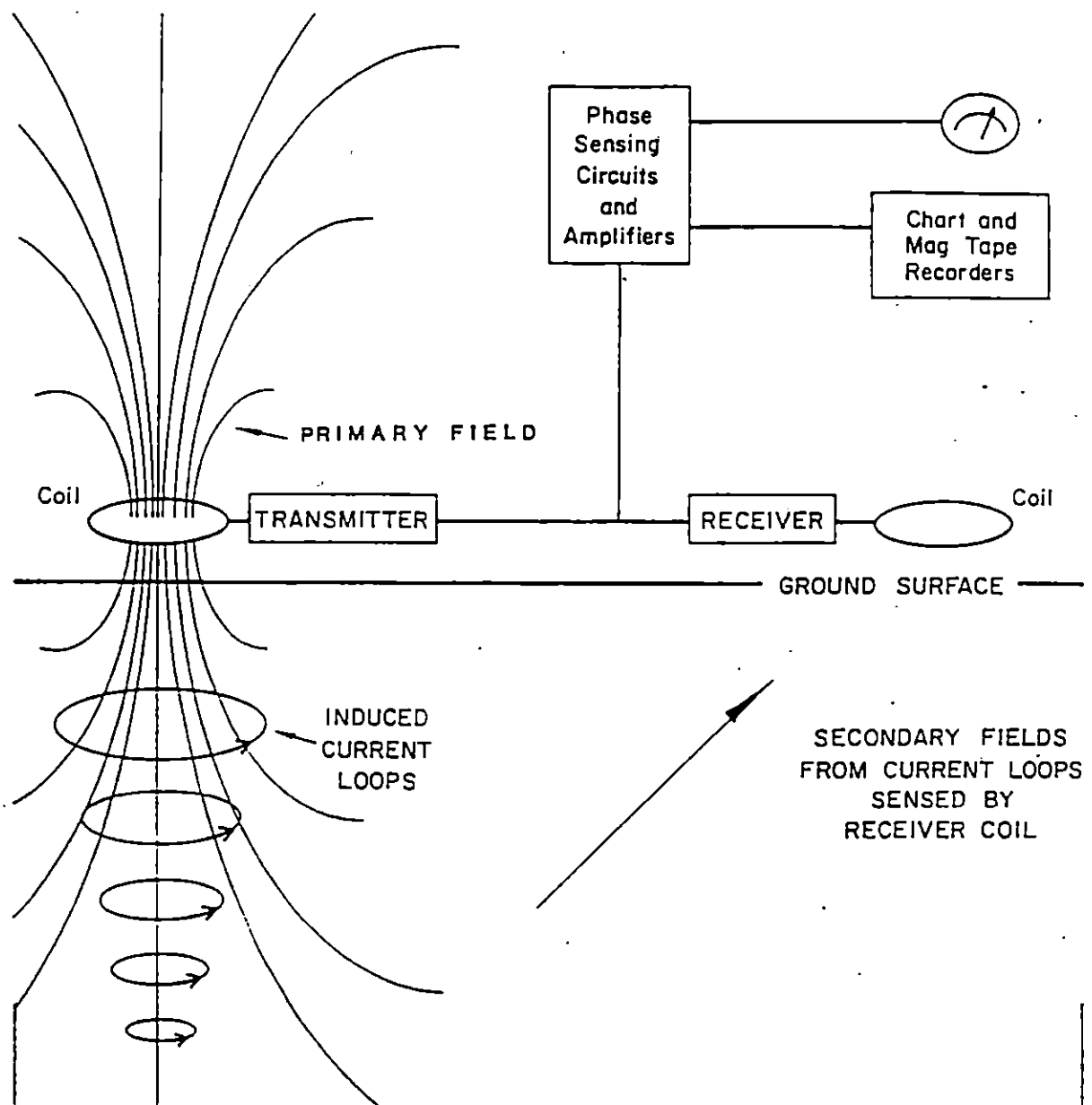
Because the EM method does not require ground contact and the equipment can be easily hand carried from station to station, surveys of large areas can be completed in relatively short periods of time. The basic principles of operation of the EM method are illustrated in Figure 3-1. The transmitter coil radiates an electromagnetic field that induces eddy currents in the earth below the instrument. Each of these eddy currents in the subsurface generates a secondary electromagnetic field. The secondary electromagnetic field is intercepted by a receiver coil, which outputs the voltage to an automated recording device. This reading is a bulk measurement of conductivity that represents a cumulative response to subsurface conditions ranging from the ground surface to the effective depth of the instrument. The sampling depth is related to the instrument's coil spacing. Depths of up to 20 meters may be investigated using this method.

The EM method may be subject to interference from above-ground transmission lines and metallic objects, therefore, their location should be noted and taken into consideration during data interpretation.

Locations and Methodology

The following three SWMUs will be investigated using EM surveys.

- SWMU 1. South Landfill
- SWMU 2. Sludge Lagoon
- SWMU 30. Residue Fill area Unit 3Fb



REFERENCE:
 GEOPHYSICAL TECHNIQUES FOR SENSING BURIED
 WASTES AND WASTE MIGRATION; BY RICHARD C. BENSON,
 ROBERT A. GLACCUM, AND MICHAEL R. NOEL OF TECHNOS,
 INC., MIAMI, FLORIDA.

FIGURE 3-1

<p>BAYER CORP. NEW MARTINSVILLE FACILITY</p>	<p>BLOCK DIAGRAM SHOWING EM PRINCIPLE OF OPERATION RFI WORK PLAN</p>	
<p>ICF KAISER ENGINEERS PITTSBURGH, PA</p>	<p>DATE: 7/14/95</p>	<p>DR.: BRENT</p>
	<p>SCALE: N.T.S.</p>	<p>DWG. NO.: BTBLA01</p>

Figures 3-2 and 3-3 provide the EM survey grid point locations for the three SWMUs. Prior to initiating the entire survey of these SWMUs, the field geophysicist will run traverses across each of the three SWMUs to ensure useful information will be provided from the entire survey. If the field geophysicist determines sufficient conductivity contrasts exist to meet survey objectives, the entire survey will be conducted.

The EM surveys will be conducted in accordance with the procedures in the QAPP Addendum (Appendix B-1). An EM31-DL terrain conductivity meter or device with similar capabilities will be used to perform the EM survey. The instrument will be calibrated in an appropriate background area prior to and after completion of each EM survey. The instrument will be operated in vertical dipole mode, and both quadrature-phase and in-phase data will be collected at each station location. The quadrature-phase is more sensitive to soil conductivity and the in-phase mode is more sensitive to metal. The instrument will be capable of automated data recording for downloading to a computer to accommodate rapid data handling and manipulation.

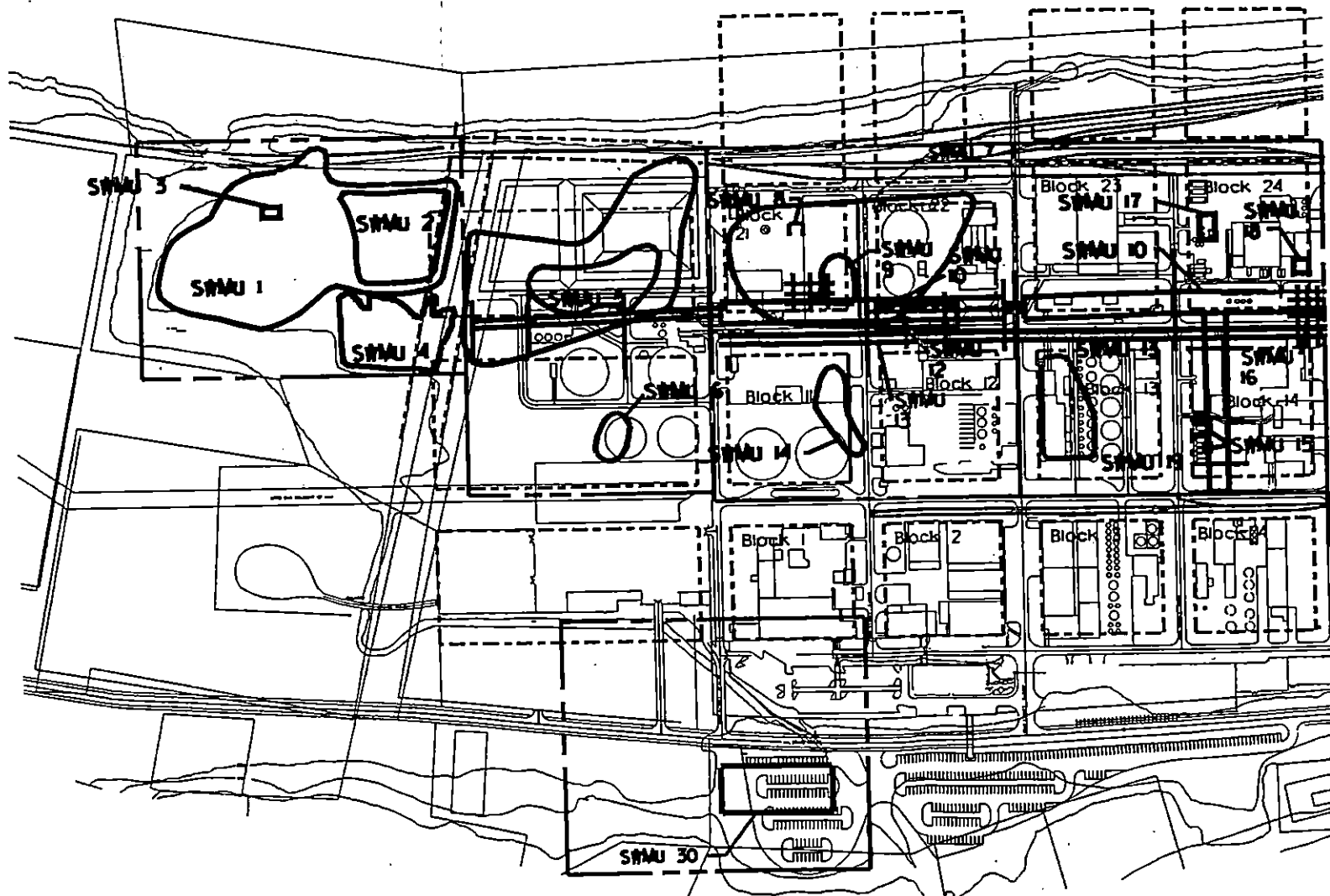
3.2.2.2 Ground Penetrating Radar (GPR) Surveys

The objective of the GPR survey is to locate boundaries and depths of infilled ditches and neutralization basins. The results of the GPR survey will be used to refine confirmatory test borings and soil sampling locations.

Overview

GPR surveys are commonly used as reconnaissance tools to evaluate lateral or vertical changes in subsurface materials. GPR uses high frequency radio waves to acquire subsurface information. GPR signals are reflected from any interface that corresponds to an abrupt change in dielectric constant, therefore, both metallic and non-metallic objects, as well as changes in geologic conditions can be detected using this method. This method is highly amenable to locating boundaries of infilled ditches or basins.

The basic principles of operation of the GPR method are illustrated in Figure 3-4. The GPR system consists of an antenna, controller, and recorder (graphic and/or magnetic tape recorder). In



LEGEND:
— GPR SURVEY LINE
--- SWMU BOUNDARY

0 300 600
SCALE IN FEET

FIGURE 3-5

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		GPR SURVEY LINE LOCATIONS SOUTHERN HALF OF FACILITY	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 9/1/95	DR.: D.M.
		SCALE: AS NOTED	DWG. NO. BTBRB12

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RFT Work Plan
Revision: 0
October 9, 1995

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Bayer Corporation
New Martinsville, WV
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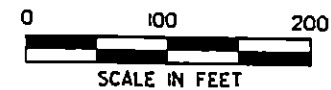
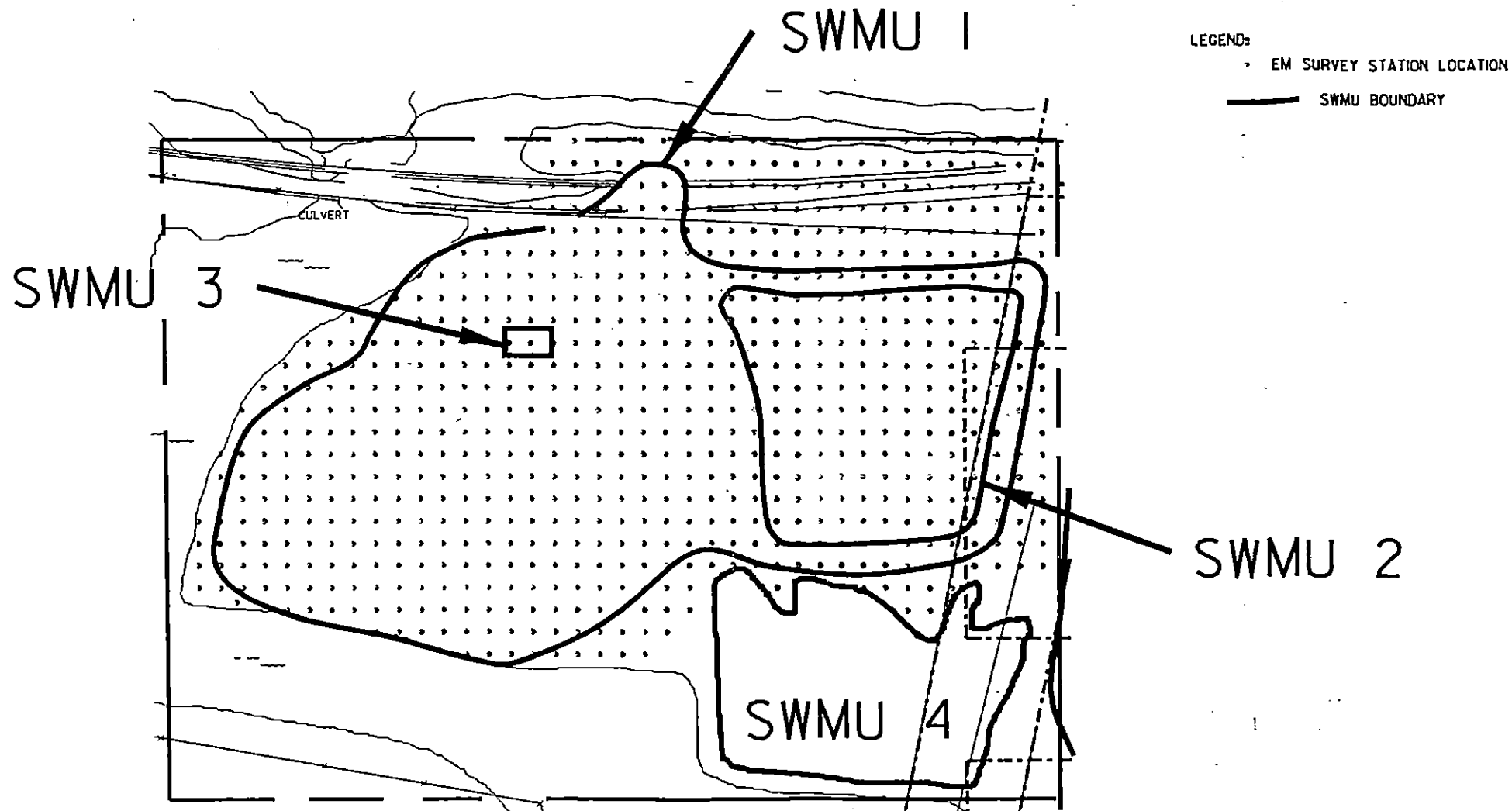
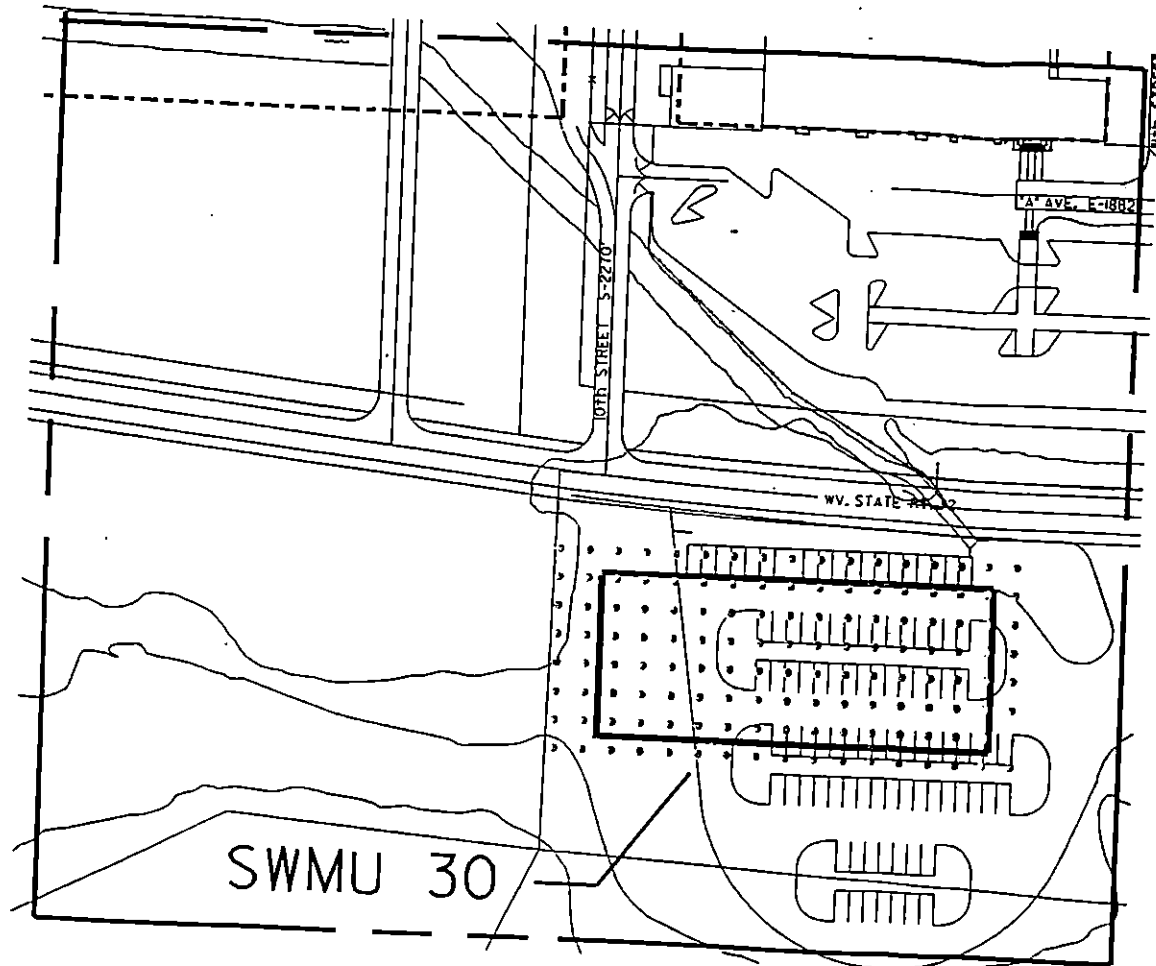


FIGURE 3-2

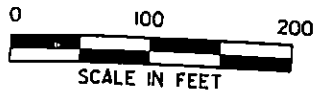
BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		SWMUS 1 AND 2 EM SURVEY GRIDS	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 8/30/95	DR.: D.M.
		SCALE: AS NOTED	DWG. NO. BTBRB08

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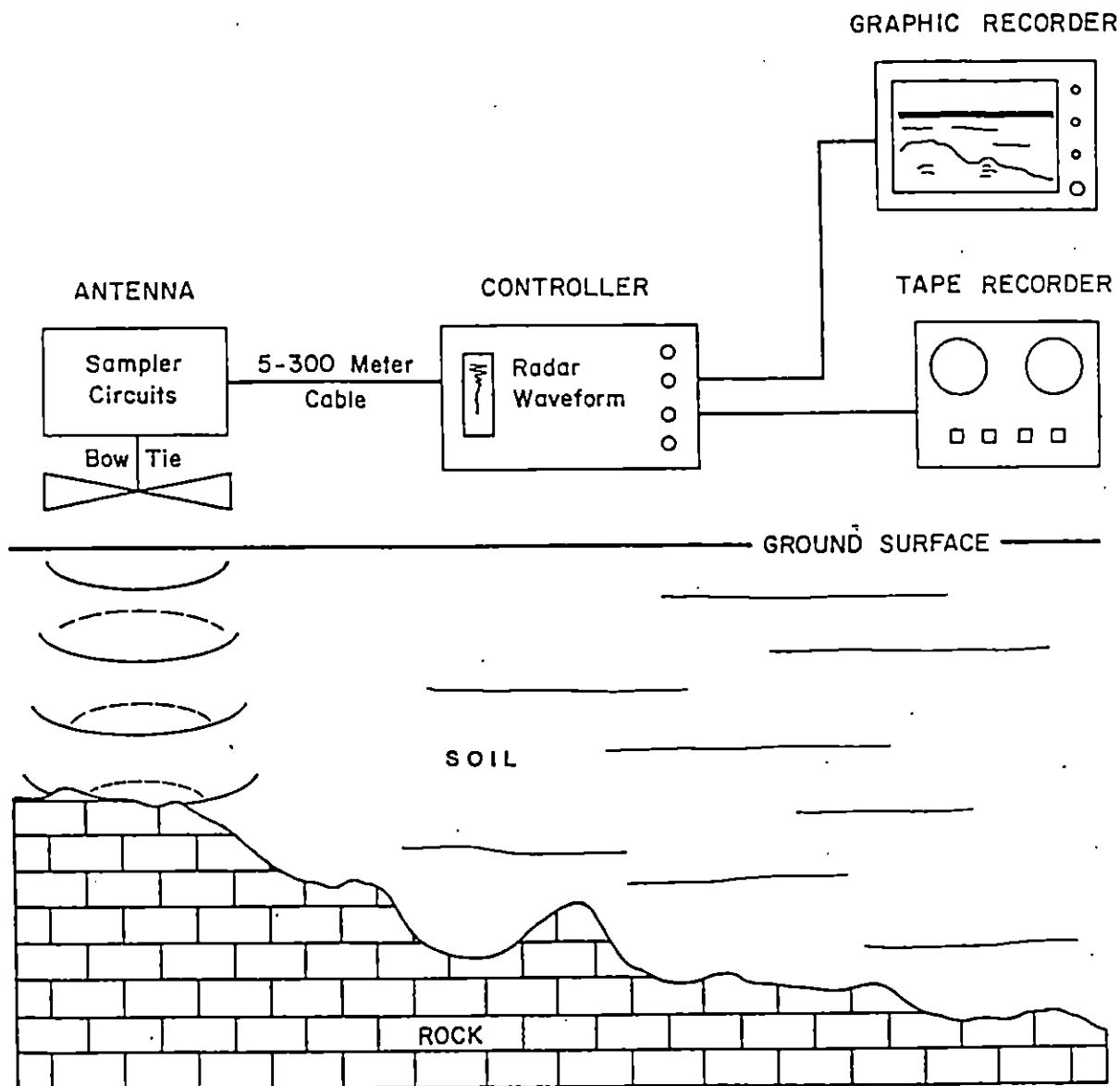
LEGEND

- EM SURVEY STATION LOCATION
- SWMU BOUNDARY



BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		FIGURE 3-3 SWMU 30 EM SURVEY GRID	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 9/1/95	DR.: D.M.
		SCALE: AS NOTED	DWG. NO. 8TBR809

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REFERENCE:
 GEOPHYSICAL TECHNIQUES FOR SENSING BURIED
 WASTES AND WASTE MIGRATION; BY RICHARD C. BENSON,
 ROBERT A. GLACCUM, AND MICHAEL R. NOEL OF TECHNOS,
 INC., MIAMI, FLORIDA.

FIGURE 3-4

BAYER CORP. NEW MARTINSVILLE FACILITY	BLOCK DIAGRAM OF GPR SYSTEM	
ICF KAISER ENGINEERS PITTSBURGH, PA	DATE: 7/14/95	DR.: BRENT
	SCALE: N.T.S.	DWG. NO.: BTBLA02

operation, the electronics are typically mounted in a vehicle. The antenna is connected by a cable and is either towed behind the vehicle or by hand.

Radio pulses radiated from the antenna are reflected back from various interfaces within the subsurface. The reflected radar waves are picked up by the receiver portion of the antenna and are returned to the control unit for processing and display. The display consists of a profile of variations in the return signal. Radar reflections from deeper reflecting horizons will appear lower on the graphic display. The depth of penetration of this method is highly site specific. Depths of up to 10 meters may be investigated using this method.

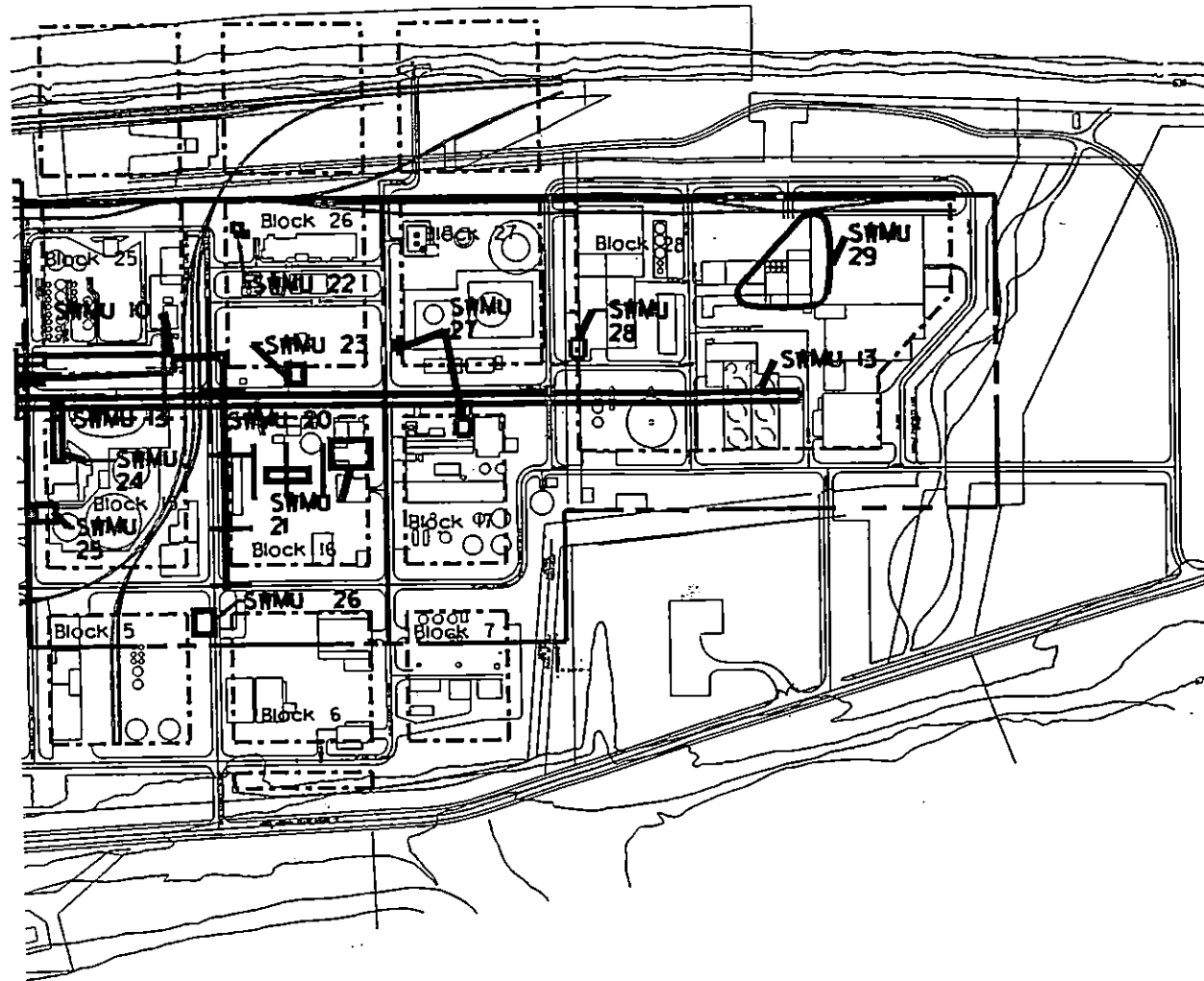
Locations and Methodology

The following SWMUs will be investigated using GPR surveys:

- SWMU 10. Infilled Wastewater Ditch (Former Process Trench)
- SWMU 11. Acid Neutralization Facility 5Fg
- SWMU 12. Former Neutralization Spill Basin
- SWMU 16. Neutralization Basin 5Fe

Figures 3-5 and 3-6 provide the locations of the GPR traverses. Prior to initiating the entire GPR survey, the field geophysicist will select and test the GPR system along a minimum of 1 line at each SWMU to ensure the method will produce useful data. After review of the GPR profiles along the lines, the field geophysicist will make a determination on whether to proceed with the entire survey.

Ground Penetrating Radar (GPR) surveys will be conducted in accordance with Section 5.7 of the QAPP. Where possible, a vehicle mounted system will be used to speed the data collection process. In addition, the GPR system utilized will be capable of recording the data on magnetic tape to facilitate data manipulation and display.



LEGEND:
— GPR SURVEY LINE
--- SMU BOUNDARY

0 300 600
SCALE IN FEET

FIGURE 3-6

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		GPR SURVEY LINE LOCATIONS NORTHERN HALF OF FACILITY	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 9/1/95	DR.: D.M.
		SCALE: AS NOTED	DWG. NO. BTBRB13

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3.2.3 RFI Task 3 - Soil Gas Survey

The objective of the soil gas survey is to identify areas where VOCs may be present in unsaturated soil or groundwater. The results of the soil gas survey will be used to guide collection of confirmation soil samples in Task 5.

3.2.3.1 Overview

Soil gas surveys are commonly used as reconnaissance tools to delineate the vertical and horizontal extent of contamination from VOCs in the vadose zone or groundwater. The presence of VOCs in soil gas indicates the observed compound may either be in the vadose zone near the probe or groundwater below the probe. Results of soil reconnaissance are useful for selecting the optimal number and location of borings required for confirmation, thus reducing the number of borings required for site characterization. Additionally, no soil cuttings which may require off-site disposal, are produced when using this intrusive method. Both of these conditions can result in significant cost savings during site characterization activities.

The soil gas method involves pumping a small amount of soil gas from the subsurface through a hollow probe that is inserted into the ground to preselected depths and into a sample collection vessel. The soil gas is analyzed for selected VOCs with an expedited turnaround time in a mobile laboratory equipped with a gas chromatograph (GC). Based on the field analytical results, subsequent soil gas locations are selected to define the lateral extent of VOCs.

3.2.3.2 Locations and Methodology

The objective of the Bayer soil gas surveys is to investigate and delineate potential VOC source areas. The data generated during this survey will be used to select locations for confirmatory soil samples in areas with both high VOCs in soil gas and low or non-detected VOCs in soil gas. The confirmatory soil samples collected in areas with high VOCs in soil gas will be used to evaluate areas suspected as having the highest potential chemical concentrations. The soil samples collected in areas with low or non-detect VOCs will be used to confirm extent of potential contamination. The following 28 SWMUs will be investigated using soil gas surveys.

- SWMU 1. South Landfill
- SWMU 2. Sludge Lagoon
- SWMU 3. Fill Area Hydroblasting Station
- SWMU 5. Residue Fill Area Unit 3Fc
- SWMU 6. Residue Fill Area Unit 3Fd
- SWMU 7. Fill Materials Block 21
- SWMU 8. All Purpose Burn Pit
- SWMU 9. Residue Fill Area Unit 3Fe
- SWMU 10. Infilled Wastewater Ditch
- SWMU 11. Acid Neutralization Basin 5Fg
- SWMU 12. Former Neutralization Spill Basin
- SWMU 13. Existing Process trench
- SWMU 14. Fill Materials Block 11
- SWMU 15. Neutralization/Settling Basin 5Fa
- SWMU 16. Neutralization Basin 5Fe
- SWMU 17. Polyol Spill
- SWMU 18. Lab Area 24A
- SWMU 19. Residue Fill Area Unit 3Fa
- SWMU 20. Nitrations Neutralization/Settling Basin 5Fb
- SWMU 21. Nitrations Neutralization/Settling Basin 5Fc
- SWMU 22. Vortex Burner
- SWMU 23. TDI Area 26B
- SWMU 24. Neutralization Trench/Basin 5Fd
- SWMU 26. Former Waste Disposal Incinerator
- SWMU 27. Mononitrobenzene
- SWMU 28. Iron Oxide Area 28A
- SWMU 29. Fill Area Block 28
- SWMU 30. Residue Fill Area Unit 3Fb

The two SWMUs not included in the soil gas survey are SWMU 4, the Ash Lagoon and SWMU 25, HCl Area 15c. The Ash Lagoon is excluded from the survey because it is filled with water. HCl Area 15C is excluded from the soil gas survey because it is a 1-foot square area with no known impact by volatile organics.

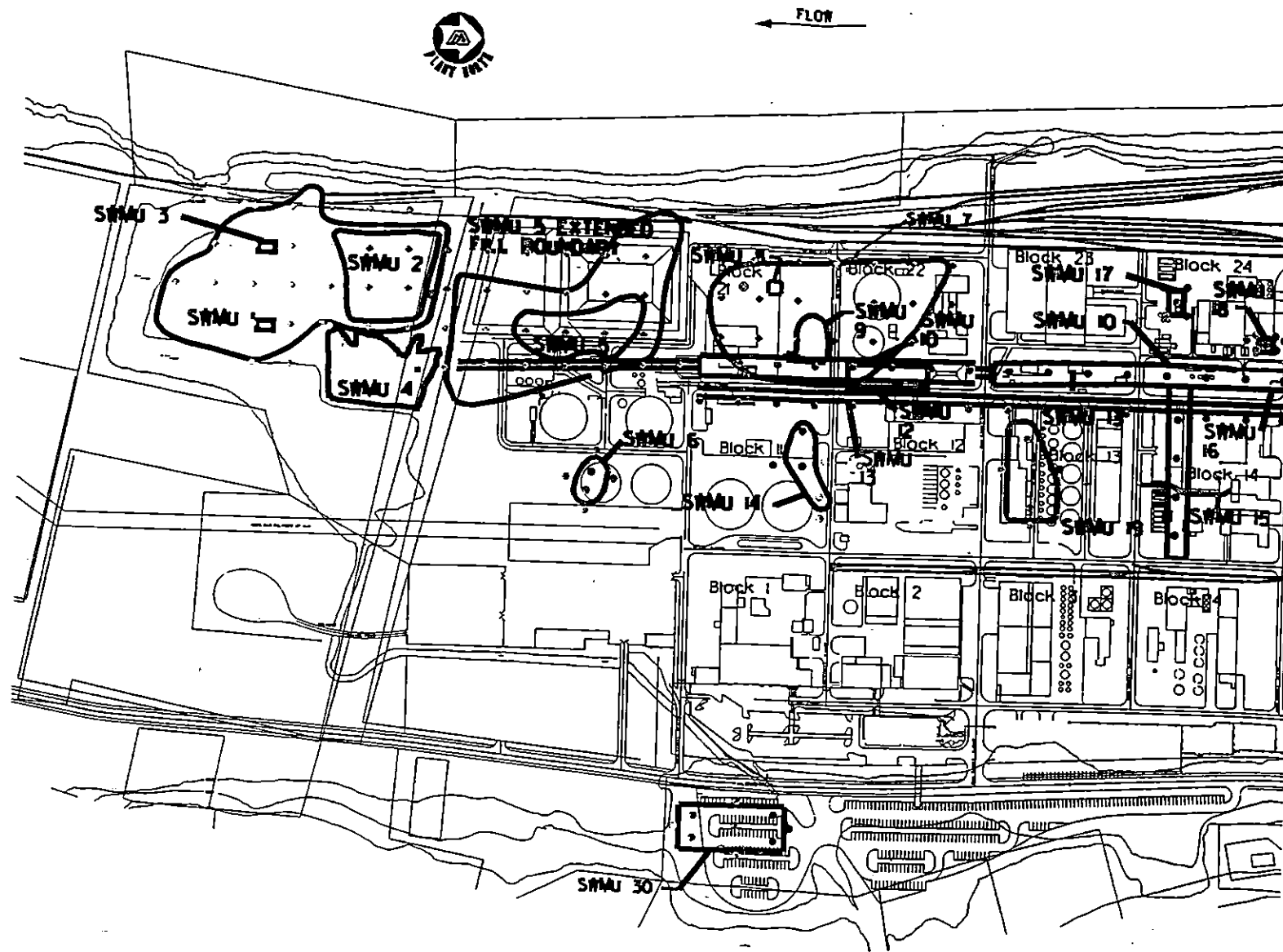
Figures 3-7 and 3-8 show the initial sample locations at each SWMU. The initial survey will consist of collecting two samples of soil gas at each of the approximately 25 soil gas sample locations. Samples will be collected at 2.5 and 7.5 ft-bgs at each of the locations. After collection of samples at the initial locations within an area and the evaluation of analytical results from the mobile laboratory, the on-site geologist will select additional soil gas sample collection locations needed to define any identified VOC contaminant plumes to within 25 feet horizontally. The top of perched groundwater in the fill material, where present, is expected at a depth ranging from approximately five feet to 15 feet-bgs. In areas where the perched water is not present, the depth to groundwater in the alluvial aquifer is approximately 20 feet-bgs. In a vertical direction, soil gas plumes will be delineated to ± 10 feet or until the water table is encountered. Based on ICF Kaiser's past experience, VOCs in soil gas at concentrations exceeding $100 \mu\text{g/l}$ are considered to be of potential concern; therefore soil gas VOCs plume limits generally will be delineated using this criteria.

The soil gas surveys will be conducted in accordance with the procedures provided in Section 5.9 of the QAPP. The soil gas sample probe will be approximately $\frac{3}{4}$ -inch diameter with minimum lengths of five feet. A truck or van equipped with a hydraulic system capable of holding, pushing, and removing the hollow probe will be the main mechanism for retrieving the soil gas samples. The van will also be equipped with a hydraulic hammer to pound the probe past prohibitive horizons. If it is necessary to collect samples on steep terrain to define the extent of contamination, a probe may be driven with a hand-held hammer-drill and removed using a hydraulic jack.

After the probe is inserted to the target depth, the aboveground end of the probe will be fitted with a steel reducer and a length of polyethylene tubing leading to a vacuum pump. Gas flow will be metered by a vacuum gauge to assure adequate flow is obtained. A minimum of five liters of gas will be evacuated with the vacuum pump prior to collecting the sample for analysis. A field GC will be used to obtain quick turnaround of soil gas analysis results.

3.2.3.3 Analytical Parameters

The soil gas survey will be limited to those VOCs used at the site which are also frequently detected during quarterly groundwater monitoring. These VOCs include:



BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		FIGURE 3-7 SOIL GAS SURVEY SAMPLE LOCATIONS SOUTHERN HALF OF FACILITY	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 9/1/95	DR.: D.M.
		SCALE: 1"=300'	DWG: NOBTBRB10



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LEGEND:

- SOIL GAS SURVEY SAMPLE LOCATION
- SWMU BOUNDARY

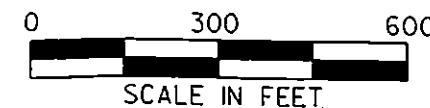
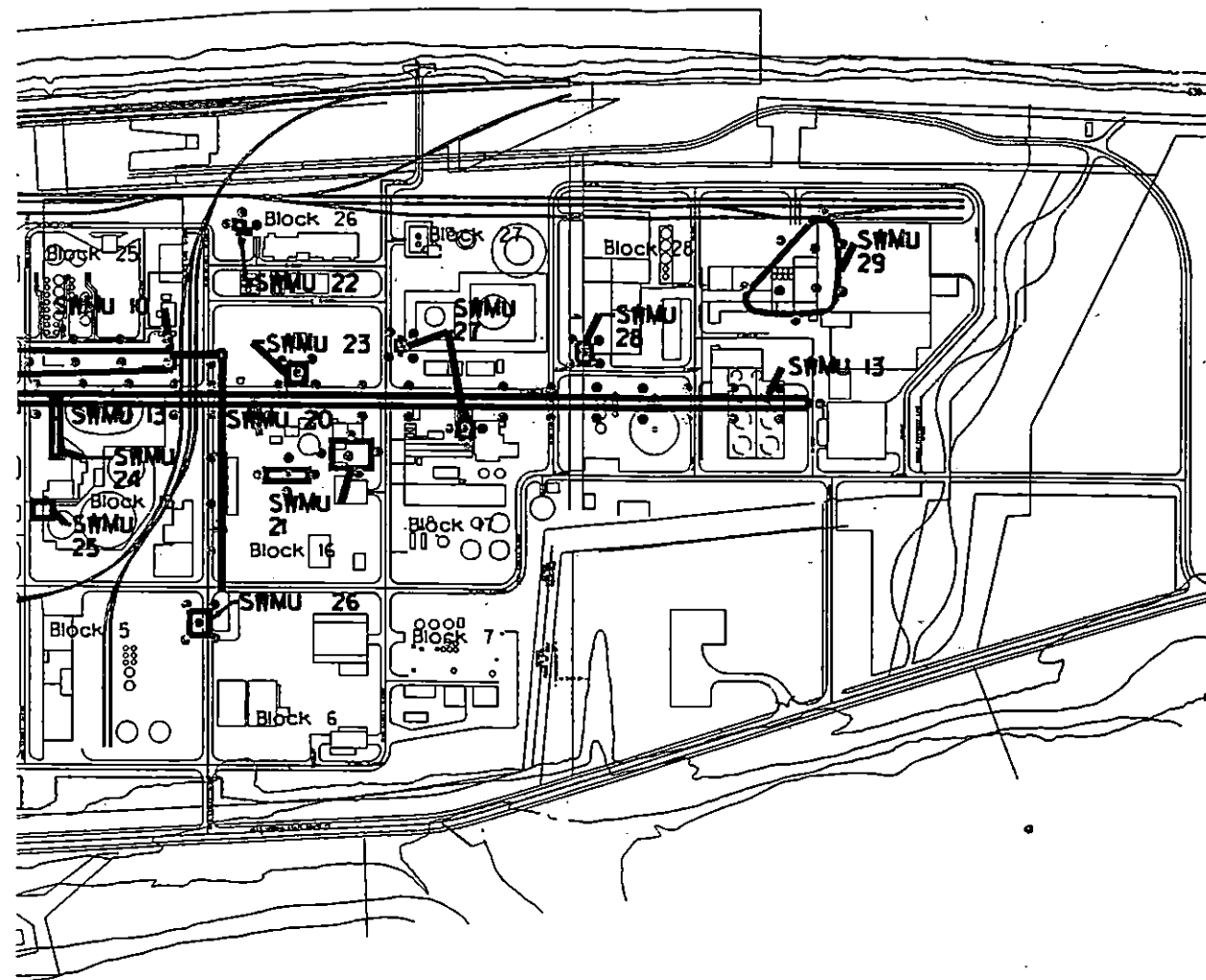


FIGURE 3-8.

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		SOIL GAS SURVEY SAMPLE LOCATIONS NORTHERN HALF OF FACILITY	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 9/1/95	DR.: D.M.
		SCALE: 1"=300'	DWG. NO: BTBRBII

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- chlorobenzene,
- 1,2-dichlorobenzene,
- 1,4-dichlorobenzene,
- benzene,
- cis-1,2-dichlorobenzene,
- toluene,
- 1,1,1-trichloroethane,
- 1,1-dichloroethane,
- 1,2-dichloroethane,
- trichloroethene,
- vinyl chloride and
- xylene.

The analytical parameters were selected based on their potential presence in the subsurface and amenability to soil gas technology. An on-site GC equipped with an electron capture detector (ECD) or a flame ionization detector (FID) will be used to conduct the analysis.

3.2.4 RFI Task 4 - CMS Groundwater Sample Collection

The objective of RFI Task 4 is to gather the information needed to identify feasible corrective measure alternatives that could potentially be implemented for sitewide groundwater. A substantial amount of VOCs, SVOCs and metals groundwater data exists for the site (ICF Kaiser, 1995a), however, there is limited or no information on the levels of indicator parameters needed to complete a CMS such as dissolved gases, organic carbon content, general chemistry properties (BOD, COD hardness, etc.) and solids content (suspended, dissolved). Groundwater samples will be collected during task 4 from selected monitoring wells and the facility's recovery wells. The samples will be submitted to the analytical laboratory to be analyzed for specific parameters potentially needed for the CMS.

3.2.4.1 Locations and Methodology

One round of groundwater samples will be collected from the 27 groundwater wells listed in Table 3-3. The wells selected for analysis include the 25 alluvial aquifer wells (22 monitoring wells and 3 recovery wells) proposed in the DOCC for inclusion in the facility's groundwater monitoring plan, plus two monitoring wells screening perched groundwater. The wells selected for CMS groundwater sampling are distributed throughout the facility; thus, data will be obtained from areas of high, medium, and low contamination as well as areas where there is no contamination. The procedures for groundwater sample collection are provided in Section 5.3 of the QAPP and the following subsections.

TABLE 3-3

MONITORING WELLS FOR CMS GROUNDWATER SAMPLE COLLECTION

Monitoring Well	Aquifer
FP-4	Alluvial
FP-12	Alluvial
FP-13	Alluvial
FP-16	Alluvial
FP-17	Alluvial
FP-19	Alluvial
GM-1P	Perched
GM-5S	Shallow Alluvial
GM-5D	Deep Alluvial
GM-13P	Perched
GM-16S	Shallow Alluvial
GM-16D	Deep Alluvial
LF-1S	Shallow Alluvial
LF-4S	Shallow Alluvial
LF-4D	Deep Alluvial
MW-3S	Shallow Alluvial
MW-3D	Deep Alluvial
MW-4S	Shallow Alluvial
MW-4D	Deep Alluvial
MW-7S	Shallow Alluvial
MW-9D	Deep Alluvial
MW-10S	Shallow Alluvial
MW-11D	Deep Alluvial
MW-12D	Deep Alluvial
RW-1	Recovery-Alluvial
RW-2	Recovery-Alluvial
RW-3	Recovery-Alluvial

Water Levels

Prior to collecting groundwater samples, water levels will be measured in the facility monitoring and recovery wells in accordance with the procedures outlined in Section 5.11.4 of the QAPP. The water level and total depth of the well will be used to calculate the height of the static water column in the monitoring wells. The static water column height and the well diameter will be used to calculate the volume of water in the well, which must be known prior to purging the monitoring wells.

Well Purging

Prior to sample collection, each monitoring well to be sampled will be purged of standing water. A stainless steel bailer, submersible pump, or a bladder pump will be used to remove a minimum of three well volumes of water from the well. Temperature, pH, and specific conductance of the purge water will be measured in the field following the removal of each well volume. The well will be considered purged when three volumes of water have been removed and pH, temperature, and specific conductance have stabilized. Temperature is considered stable when three consecutive readings are within $\pm 0.5^{\circ}$ Celsius. The pH is considered stable when three consecutive readings are within ± 0.1 Standard Units and specific conductance is considered stable when three consecutive readings are within $\pm 10\%$.

Facility recovery wells will not require purging prior to sampling because they are continuously operated. Immediately prior to collecting samples from the recovery wells for submittal to the analytical laboratory, temperature, pH, and specific conductance of water collected from recovery well sampling ports will be measured and recorded. In the unlikely event that a recovery well is not in operation at the time of sampling, the well will be placed into operation and pumped for a minimum period of one hour prior to sampling.

Sample Collection

Groundwater samples will be collected from the monitoring wells immediately after purging is completed and when the water level has returned to a minimum of 70% of the static water column.

In the event that a well recovers slowly (i.e. less than 70% of static in one hour), the water in the well will be allowed to recover for up to 24 hours prior to sample collection.

Groundwater samples for laboratory analysis will be collected from monitoring wells by gently lowering a stainless steel bailer into the water to retrieve the sample. Water will be transferred directly from the bailer into sample containers. Groundwater samples for laboratory analysis will be collected from the recovery wells from the sampling port directly into the appropriate sample container. All samples will be preserved with the appropriate preservative. Preservative requirements for groundwater samples are listed in Section 5.3 of the QAPP.

3.2.4.2 Analytical Parameters

Laboratory analysis of groundwater samples will be for parameters that are needed to evaluate potential corrective measure alternatives. Table 3-4 lists the parameters that groundwater water will be analyzed for under RFI Task 4.

3.3 PHASE 2 DATA COLLECTION

3.3.1 RFI Task 5 - Confirmatory Test Borings and Soil Sample Collection

Soil sample collection, both at the surface and from the subsurface, will be the key element in the RFI to determine whether or not a release to the environment from a SWMU has occurred at levels of potential concern. The primary objectives of Task 5 include gathering information needed to; 1) provide the soil analytical data needed for the screening level risk assessment; 2) provide physical characterization of the soil, 3) provide initial information on nature and extent of contamination, and 4) provide chemical and physical information potentially needed for risk assessment modeling activities and the CMS.

3.3.1.1 Soil Sampling Methodology

Test borings will be installed during RFI Task 5 using hollow stem auger (HSA) drilling methods in areas that are relatively free from overhead obstruction (i.e. pipe racks, etc.) and whose total depth

TABLE 3-4

ANALYTE LIST FOR CMS GROUNDWATER SAMPLE COLLECTION

INDICATOR PARAMETERS
Total Suspended Solids
BOD
COD
Total Kjeldahl Nitrogen
Oil and Grease

exceeds 20 feet-bgs. These areas are located primarily on the southern end of the facility in the landfill, warehouse, and water treatment areas. Test borings in the plant operations areas near the central and northern part of the facility where it would be difficult or not possible to use a HSA rig will be installed using a Geoprobe™ or equivalent device. Table 3-5 lists the planned drilling method for each SWMU.

Surface and subsurface soil samples will be collected in accordance with Sections 5.1 and 5.2 of the QAPP. Soil samples will be collected continuously from the surface to the base of the borehole. All soil samples will be screened using an OVM and logged according to the Unified Soil Classification System (USCS).

In each of the test borings, surface soil samples from the 0 to 0.5 foot interval will be collected for laboratory analysis. Subsurface soil samples from the 3 to 5 foot interval and the 2-foot interval immediately above the first groundwater (i.e. perched zone or alluvial aquifer) will be collected from all test borings. One or two additional, subsurface soil samples will also be collected from the vadose zone in each boring for submittal to the analytical laboratory according to the following selection criteria (in order of preference):

- highest OVM readings during sample field screening;
- visual evidence of contamination (staining, odor, free product, waste, etc.); and,
- stratigraphic change in the soil profile.

If a perched zone is encountered, the boring will be advanced to the top of the alluvial aquifer water table. A sample from the unsaturated zone below the perched zone comprised of the two-foot interval above the alluvial aquifer water table will also be submitted for analysis. Other samples in the unsaturated zone beneath the perched zone will be submitted if warranted using the three criteria (OVM, visual evidence, or stratigraphic change) previously discussed. Any soil samples collected from saturated zones will be logged but will not be submitted for laboratory analysis.

After the completion of sample collection, all test borings will be abandoned by filling from the bottom of the test hole to the surface with a neat cement/bentonite grout (four pounds of commercial bentonite and approximately 7.5 gallons of water to every 94 pound bag of Portland Type II cement). Where the bottom of the boring is clearly visible from the land surface (maximum depth

TABLE 3-5

PLANNED DRILLING METHOD BY SWMU

Hollow Stem Auger Drilling Method	<ol style="list-style-type: none"> 1. South Landfill 2. Sludge Lagoon 3. Fill Area Hydroblasting Station 4. Ash Lagoon 5. Residue Fill Area Unit 3Fc 6. Residue Fill Area Unit 3Fd 7. Fill Materials Block 21 8. All Purpose Burn Pit 9. Residue Fill Area Unit 3Fe 30. Residue Fill Area Unit 3Fb
Geoprobe Drilling Method	<ol style="list-style-type: none"> 10. Infilled Wastewater Ditch 11. Acid Neutralization Basin 5Fg 12. Former Neutralization Spill Basin 13. Existing Process trench 14. Fill Materials Block 11 15. Neutralization/Settling Basin 5Fa 16. Neutralization Basin 5Fe 17. Polyol Spill 18. Lab Area 24A 19. Residue Fill Area Unit 3Fa 20. Nitrations Neutralization/Settling Basin 5Fb 21. Nitrations Neutralization/Settling Basin 5Fc 22. Vortex Burner 23. TDI Area 26B 24. Neutralization Trench/Basin 5Fd 25. HCl Acid Area 15C⁽¹⁾ 26. Former Waste Disposal Incinerator 27. Mononitrobenzene 28. Iron Oxide Area 28A 29. Fill Area Block 28

Notes: (1) Surface samples will also be collected using hand-auger due to restricted vehicle access.

approximately 15 feet) grout may be gravity placed. Where test boring depths exceed 15 feet or the bottom of the borehole is not visible, grout will be placed under pressure using a tremie pipe. Where test borings are drilled through liners, concrete, asphalt or brick covered areas, these materials will be repaired to maintain the integrity of the covering.

The location of proposed initial test borings, sample depth intervals and the proposed analytical parameters are provided in the following subsections. The locations proposed are tentative and may be adjusted based on the Phase 1 investigation results, if warranted. Most of the Phase 2 soil samples will be collected from test borings in areas where the Phase 1 reconnaissance investigations have indicated that contaminants are likely to be present; however, some samples will also be collected in areas where Phase 1 results indicate contamination is absent in order to confirm contamination is absent at levels of concern. The locations may also be adjusted to avoid drilling through underground utility and containment liners. If contaminants are detected in the samples at unacceptable levels as determined by the risk assessment conducted at the end of Phase 2, then additional soil samples will be proposed for collection in Phase 3. The location of additional test borings (beyond what is scoped in this section) for further delineation of the extent of contaminants will be based on the results of the Phase 1 and 2 investigations and will be conducted under Phase 3 (Task 8).

3.3.1.2 Locations and Analytes

The remainder of Section 3.3.1 provides the specific locations, sample depth intervals, and analytes proposed for each SWMU. A series of figures is presented that show the locations of all proposed Phase 2 test borings. Table 3-6 summarizes for each SWMU the number of Phase 2 borings, their anticipated total depth, sample depth intervals, and analytes. The locations of all Phase 2 borings illustrated in this section may be revised if warranted by the results of Phase 1. Any significant revision to Phase 2 sample locations illustrated in this document will be discussed with the EPA project manager during presentation of the results at the end of each Phase (see Section 2.4).

SWMU 1. South Landfill

Seven test borings will be installed through the base of fill material and into natural underlying material (anticipated to be at a maximum depth of 45 feet-bgs) at the locations illustrated in Figure 3-9. Three of the seven borings will be installed in the landfill to confirm the thickness of waste.

TABLE 3-6

SWMU SOIL SAMPLING SUMMARY

SWMU Number	Boring Number	Estimated Boring Depth	Sample Intervals				
			Surface ⁽¹⁾	3 to 5 ft-bgs	2-foot Interval Above Alluvial Aquifer Water Table ⁽²⁾	2-foot Interval Above Perched Groundwater ⁽³⁾	Others As Indicated By Field Findings ⁽⁴⁾
1	SM001-TB01	45	A ⁽⁵⁾	A	A	A	A
	SM001-TB02	45	A,B ⁽⁶⁾	A	A	A	A
	SM001-TB03	45	A	A	A	A	A
	SM001-TB04	45	A,C ⁽⁷⁾	A,C	A	A	A,C
	SM001-TB05	45	A	A	A	A	A
	SM001-TB06	45	A	A	A	A	A
	SM001-TB07	45	A	A	A	A	A
2	SM002-TB01	45	A	A	A	A	A
	SM002-TB02	45	A,B	A,C	A	A	A,C
	SM002-TB03	45	A	A,B	A	A	A
3	SM003-TB01	20	A	A	A	A	A
	SM003-TB02	20	A	A	A	A	A
4	SM004-TB01	45	A,B	A	A	A	A
	SM004-TB02	45	A	A	A	A	A
	SM004-TB03	45	A	A,B	A	A	A
	SM004-TB04	45	A	A	A	A	A
5	SM005-TB01	20	A	A	A	A	A
	SM005-TB02	20	A	A	A	A	A
	SM005-TB03	20	A,B	A	A	A	A,B,D ⁽⁸⁾
	SM005-TB04	20	A	A,C	A	A	A,C
	SM005-TB05	20	A	A,E ⁽⁹⁾	A	A	A,E
6	SM006-TB01	20	A	A	A	A	A
	SM006-TB02	20	A,B	A,E	A	A	A,E
	SM006-TB03	20	A	A	A	A	A

See notes at end of table.

TABLE 3-6 (Continued)

SWMU SOIL SAMPLING SUMMARY

SWMU Number	Boring Number	Estimated Boring Depth	Sample Intervals				
			Surface ⁽¹⁾	3 to 5 ft-bgs	2-foot Interval Above Alluvial Aquifer Water Table ⁽²⁾	2-foot Interval Above Perched Groundwater ⁽³⁾	Others As Indicated By Field Findings ⁽⁴⁾
7	SM007-TB01	20	A,B	A	A	A	A
	SM007-TB02	20	A	A	A	A	A
	SM007-TB03	20	A	A	A	A	A
	SM007-TB04	20	A	A,E	A	A	A,D,E
8	SM008-TB01	20	A,B	A,E	A	A	A,D,E
9	SM009-TB01	20	A	A	A	A	A
	SM009-TB02	20	A,B	A,E	A	A	A,D,E
	SM009-TB03	20	A	A	A	A	A
10	SM010-TB01	20	A	A	A	A	A
	SM010-TB02	20	A,B	A,E	A	A	A,E
	SM010-TB03	20	A	A	A	A	A
	SM010-TB04	20	A	A	A	A	A
	SM010-TB05	20	A,B	A,E	A	A	A,E
	SM010-TB06	20	A	A	A	A	A
	SM010-TB07	20	A	A	A	A	A
	SM010-TB08	20	A,B	A,E	A	A	A,E
	SM010-TB09	20	A	A	A	A	A
	SM010-TB10	20	A	A	A	A	A
	SM010-TB11	20	A,B	A,E	A	A	A,E
	SM010-TB12	20	A	A	A	A	A
	SM010-TB13	20	A	A	A	A	A
	SM010-TB14	20	A,B	A,E	A	A	A,E
	SM010-TB15	20	A	A	A	A	A
	SM010-TB16	20	A	A	A	A	A

See notes at end of table.

TABLE 3-6 (Continued)

SWMU SOIL SAMPLING SUMMARY

SWMU Number	Boring Number	Estimated Boring Depth	Sample Intervals				
			Surface ⁽¹⁾	3 to 5 ft-bgs	2-foot Interval Above Alluvial Aquifer Water Table ⁽²⁾	2-foot Interval Above Perched Groundwater ⁽³⁾	Others As Indicated By Field Findings ⁽⁴⁾
10 [Continued]	SM010-TB17	20	A,B	A,E	A	A	A,E
	SM010-TB18	20	A	A	A	A	A
11	SM011-TB01	20	A,B	A,B	A	A	A
12	SM012-TB01	20	A	A	A	A	A
	SM012-TB02	20	A,E	A	A	A	A,E
	SM012-TB03	20	A	A	A	A	A
13	SM013-TB01	20	A,B	A	A	A	A
	SM013-TB02	20	A	A,B	A	A	A,B
	SM013-TB03	20	A	A	A	A	A
	SM013-TB04	20	A,B	A	A	A	A
	SM013-TB05	20	A	A,B	A	A	A,B
	SM013-TB06	20	A	A	A	A	A
	SM013-TB07	20	A	A	A	A	A
	SM013-TB08	20	A,B	A	A	A	A,B
14	SM014-TB01	20	A	A	A	A	A
	SM014-TB02	20	A,B	A,E	A	A	A,D,E
	SM014-TB03	20	A	A	A	A	A
15	SM015-TB01	20	A	A	A	A	A
	SM015-TB02	20	A,B	A,E	A	A	A,E
	SM015-TB03	20	A	A	A	A	A
	SM015-TB04	20	A	A	A	A	A
16	SM016-TB01	20	A,B	A,B	A	A	A,B

See notes at end of table.

TABLE 3-6 (Continued)

SWMU SOIL SAMPLING SUMMARY

SWMU Number	Boring Number	Estimated Boring Depth	Sample Intervals				
			Surface ⁽¹⁾	3 to 5 ft-bgs	2-foot Interval Above Alluvial Aquifer Water Table ⁽²⁾	2-foot Interval Above Perched Groundwater ⁽³⁾	Others As Indicated By Field Findings ⁽⁴⁾
17	SM017-TB01	20	A	A,B	A	A	A,B
	SM017-TB02	20	A,B	A	A	A	A,B
18	SM018-TB01	20	A,B	A	A	A	A,B
19	SM019-TB01	20	A	A	A	A	A
	SM019-TB02	20	A,B	A	A	A	A
	SM019-TB03	20	A	A,E	A	A	A,D,E
	SM019-TB04	20	A	A	A	A	A
20	SM020-TB01	20	A,B	A	A	A	A
	SM020-TB02	20	A	A,E	A	A	A,E
21	SM021-TB01	20	A,B	A	A	A	A
	SM021-TB02	20	A	A,E	A	A	A,E
22	SM022-TB01	20	A,B	A	A	A	A,B
	SM022-TB02	20	A	A,E	A	A	A,E
	SM022-TB03	20	A	A	A	A	A
23	SM023-TB01	20	A,B	A	A	A	A
	SM023-TB02	20	A	A,B	A	A	A,B,D
24	SM024-TB01	20	A,B	A	A	A	A
	SM024-TB02	20	A	A,E	A	A	A,E
25	SM025-TB01	20	A,B	A	A	A	A
26	SM026-TB01	20	A	A,B	A	A	A,B
	SM026-TB02	20	A,B	A	A	A	A
27	SM027-TB01	20	A,B	A	A	A	A
	SM027-TB02	20	A	A,E	A	A	A,E

See notes at end of table.

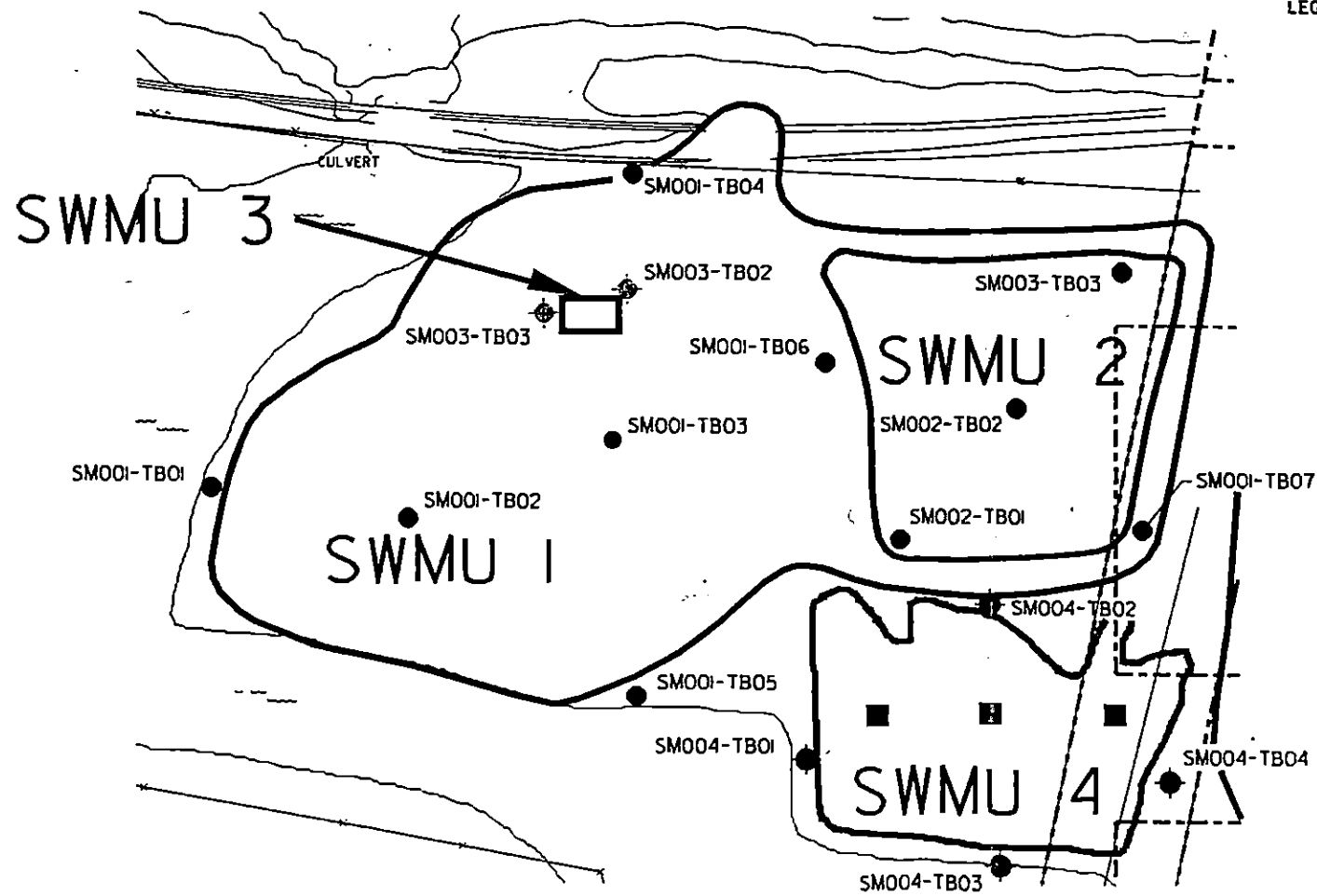
TABLE 3-6 (Continued)

SWMU SOIL SAMPLING SUMMARY

SWMU Number	Boring Number	Estimated Boring Depth	Sample Intervals				
			Surface ⁽¹⁾	3 to 5 ft-bgs	2-foot Interval Above Alluvial Aquifer Water Table ⁽²⁾	2-foot Interval Above Perched Groundwater ⁽³⁾	Others As Indicated By Field Findings ⁽⁴⁾
28	SM028-TB01	20	A,B	A	A	A	A
	SM028-TB02	20	A	A,B	A	A	A,B
29	SM029-TB01	20	A,B	A	A	A	A
	SM029-TB02	20	A	A,E	A	A	A,D,E
30	SM030-TB01	20	A,B	A	A	A	A
	SM030-TB02	20	A	A,C	A	A	A,C,D
	SM030-TB03	20	A	A,E	A	A	A,D,E

Notes:

- (1) Surface samples will be collected from the 0 to 6 inch interval. If the area is covered (i.e., with gravel, concrete, asphalt, etc.), the surface sample will be collected from the 0 to 6 inch interval immediately below the covering. Surface geotechnical samples will be collected from 0 to 3 feet.
- (2) Sample to be collected from two-foot vadose zone interval above alluvial aquifer. In fill areas that are beneath the water table (i.e., SWMUs 1 and 2) sample will be collected from the deepest vadose zone two-foot interval.
- (3) Sample to be collected from two-foot interval above perched groundwater where perched conditions are found.
- (4) One to two additional samples to be collected from the vadose zone according to the following criteria (in order of preference):
1. Highest OVM field screening result.
 2. Visual evidence of contamination.
 3. Stratigraphic change in the soil profile.
- (5) "A" - indicates sample to be analyzed for the site parameter list provided in Table 2-4.
- (6) "B" - indicates sample to be analyzed for grain size distribution and hydrometer, bulk density, and TOC. Sample will be collected from a second boring made next to the initial boring to obtain sufficient sample volume.
- (7) "C" - indicates sample to be analyzed for grain size distribution and hydrometer, moisture content, specific gravity, Atterburg limits, and consolidation.
- (8) "D" - indicates one to two samples of TDI residue from the boring indicated are to be submitted and analyzed for 2,4- and 2,6-TDI.
- (9) "E" - indicates sample to be analyzed for grain size distribution and hydrometer, BTU value, % ash, flash point, moisture content, bulk density, permeability, TOC and pH.



LEGEND:

- SWMU 1 PROPOSED TEST BORING LOCATION
- SWMU 2 PROPOSED TEST BORING LOCATION
- ⊗ SWMU 3 PROPOSED TEST BORING LOCATION
- ⊗ SWMU 4 PROPOSED TEST BORING LOCATION
- SWMU 4 PROPOSED LAGOON WATER AND SEDIMENT SAMPLE LOCATION
- SWMU BOUNDARY



FIGURE 3-9

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY	PROPOSED SAMPLE LOCATIONS- SWMUS 1, 2, 3 AND SWMU 4	
	DATE: 8/30/95	DR.: D.M.
ICF KAISER ENGINEERS PITTSBURGH, PA	SCALE: AS NOTED	DWG. NO. BTBRB01

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The remaining four test borings will be installed around the perimeter to assess the material used to construct the berms.

Soil samples will be collected from borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 1 on Table 3-6.

SWMU 2. Sludge Lagoon

Three test borings will be installed through the base of lagoon/berm materials and into natural underlying material (anticipated to be at a maximum depth of 45 ft-bgs) at the locations illustrated in Figure 3-9. Soil samples will be collected from borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 2 on Table 3-6.

SWMU 3. Fill Area Hydroblasting Station

Two test borings will be installed immediately adjacent to the Hydroblasting Station concrete pad at the locations illustrated in Figure 3-9. The northern-most of the two borings will be located adjacent to the Hydroblasting Station sump area. Each boring will be advanced until groundwater is encountered, which is expected to be no deeper than 15 feet-bgs. Soil samples will be collected from borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 3 on Table 3-6.

SWMU 4. Ash Lagoon

Four test borings, one on each side of the Ash Lagoon, will be installed through the base of berm materials and into natural underlying material (anticipated to be at a maximum depth of 45 ft-bgs) at the locations illustrated in Figure 3-9. Soil samples will be collected from borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 4 on Table 3-6.

SWMU 5. Residue Fill Area Unit 3Fc

Five test borings will be installed within the extended fill boundary of SWMU 5 at the locations illustrated in Figure 3-10. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 20 ft-bgs). If the alluvial aquifer water table has not been encountered within the first 20 feet of the boring, the boring will continue to be advanced to the top of the water table. Soil samples will be collected from borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 5 on Table 3-6.

SWMU 6. Residue Fill Area Unit 3Fd


Three test borings will be installed in SWMU 6 at the location illustrated in Figure 3-10. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 15 ft-bgs). Each boring will continue to be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected from the boring at the depths indicated and parameters listed for SWMU 6 on Table 3-6.

SWMU 7. Fill Materials Block 21

Four test borings will be installed at SWMU 9 at the locations illustrated in Figure 3-11. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 20 ft-bgs). If the alluvial aquifer water table has not been encountered within the first 20 feet of the borings, the borings will continue to be advanced to the top of the water table. Soil samples will be collected from borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 7 on Table 3-6.

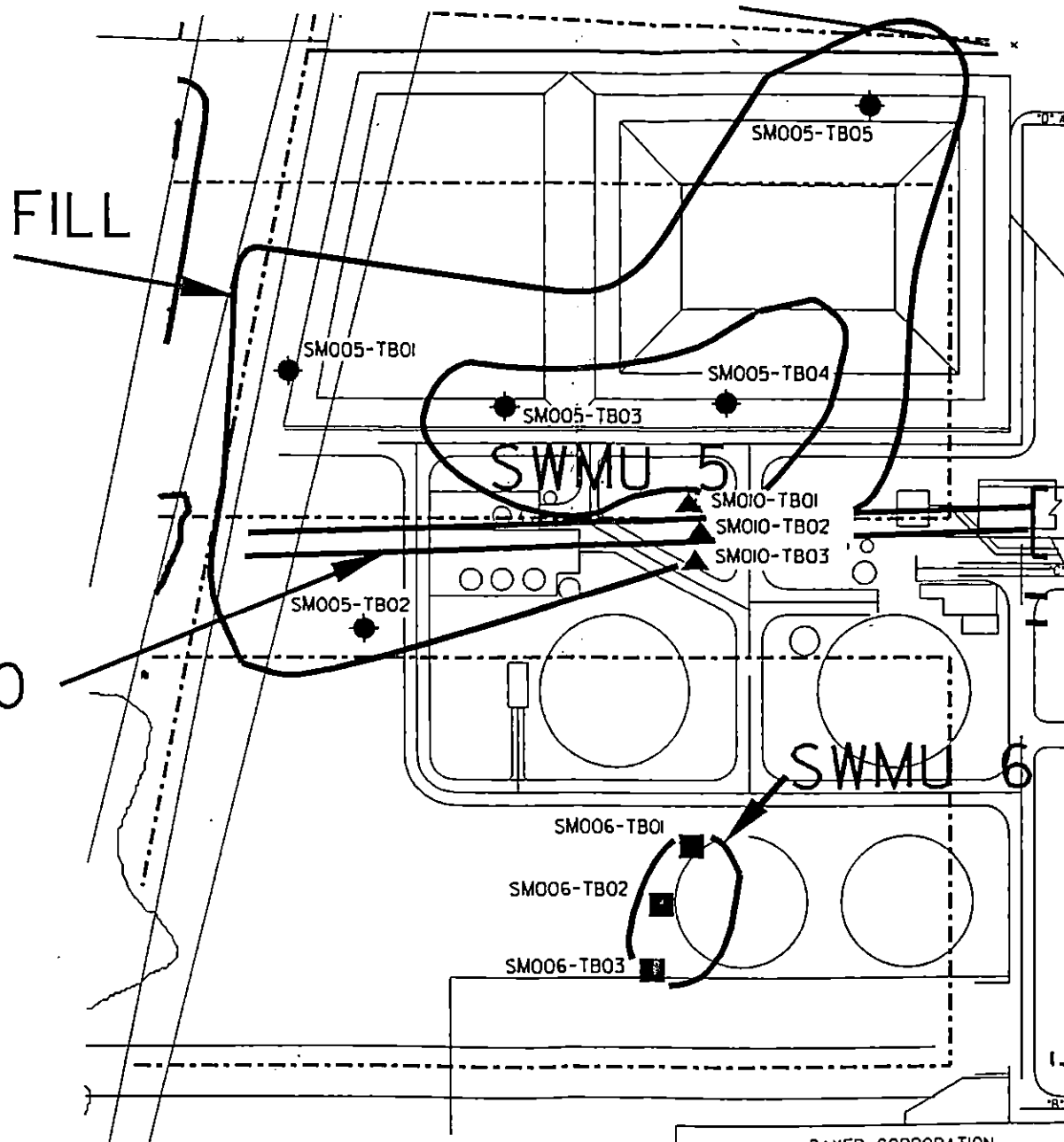
SWMU 8. All Purpose Burn Pit

One test boring will be installed at SWMU 8 at the locations illustrated in Figure 3-11. The boring will be advanced through fill materials and into underlying natural material (anticipated to be no


SWMU 5
EXTENDED
BOUNDARY

FILL

SWMU 10



LEGEND:

- SWMU 5 PROPOSED TEST BORING LOCATION
- SWMU 6 PROPOSED TEST BORING LOCATION
- ▲ SWMU 10 PROPOSED TEST BORING LOCATION
- SWMU BOUNDARY



FIGURE 3-10

BAYER CORPORATION
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PROPOSED SAMPLE LOCATIONS-
SWMUS 5 AND 6

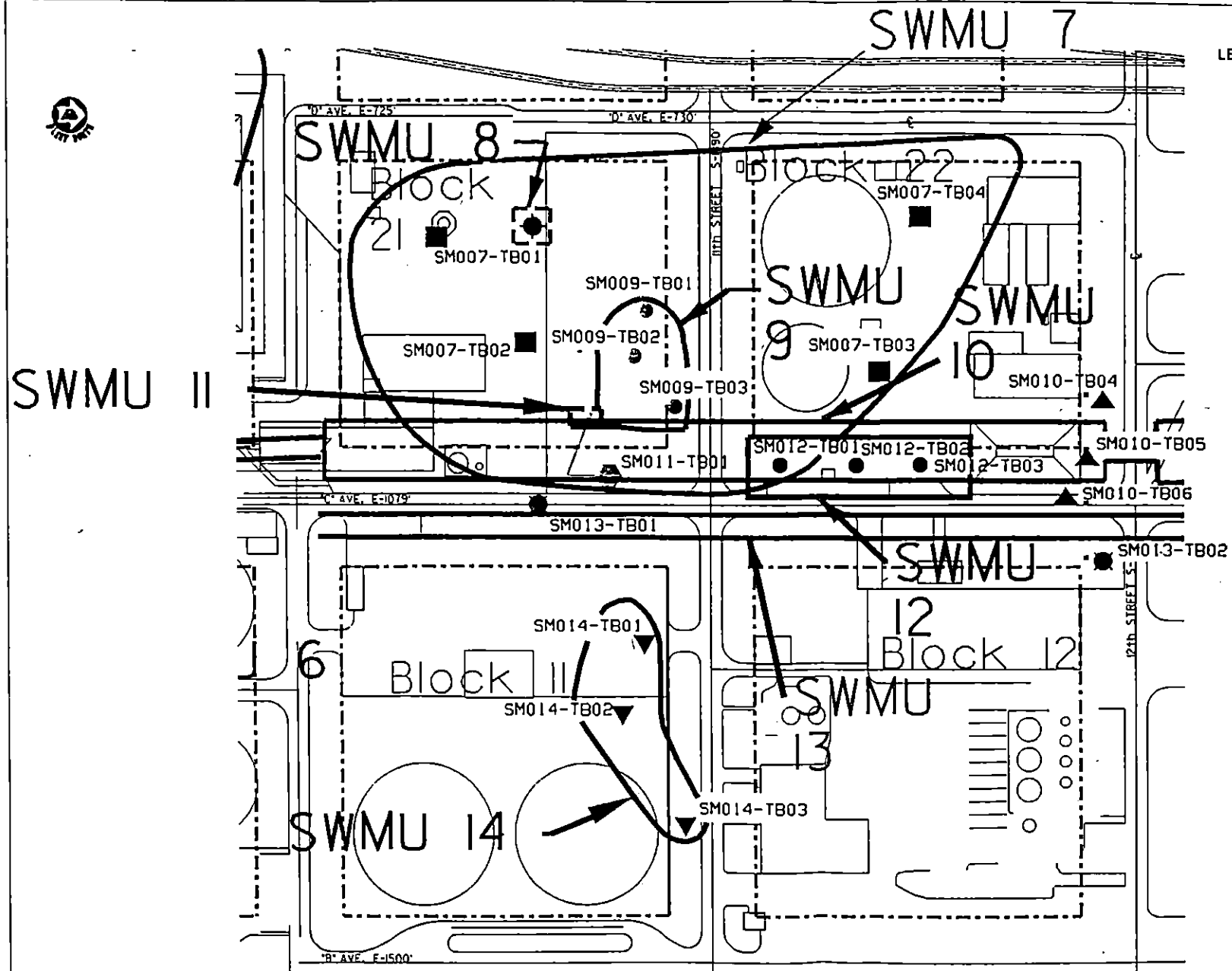
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DATE: 8/30/95

DR. : D.M.

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LEGEND:

- SWMU 7 PROPOSED TEST BORING LOCATION
- SWMU 8 PROPOSED TEST BORING LOCATION
- SWMU 9 PROPOSED TEST BORING LOCATION
- ▲ SWMU 10 PROPOSED TEST BORING LOCATION
- ◆ SWMU 11 PROPOSED TEST BORING LOCATION
- SWMU 12 PROPOSED TEST BORING LOCATION
- SWMU 13 PROPOSED TEST BORING LOCATION
- ▼ SWMU 14 PROPOSED TEST BORING LOCATION
- SWMU BOUNDARY

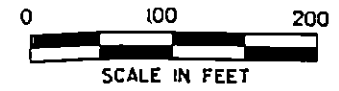


FIGURE 3-II

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		PROPOSED SAMPLE LOCATIONS- SWMU 7, 8, 9, 10, 11, 12, 13, AND 14	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 8/30/95	DR. :
		SCALE: AS NOTED	DWG. NO. BTBRB03

deeper than 20 ft-bgs). If the alluvial aquifer water table has not been encountered within the first 20 feet of the boring, the boring will continue to be advanced to the top of the water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected from the boring at the depths indicated and parameters listed for SWMU 8 on Table 3-6. If the concrete bricks which reportedly lined the base of the burn pit are encountered, one soil sample will be collected from immediately beneath them (unless they are in the saturated zone).

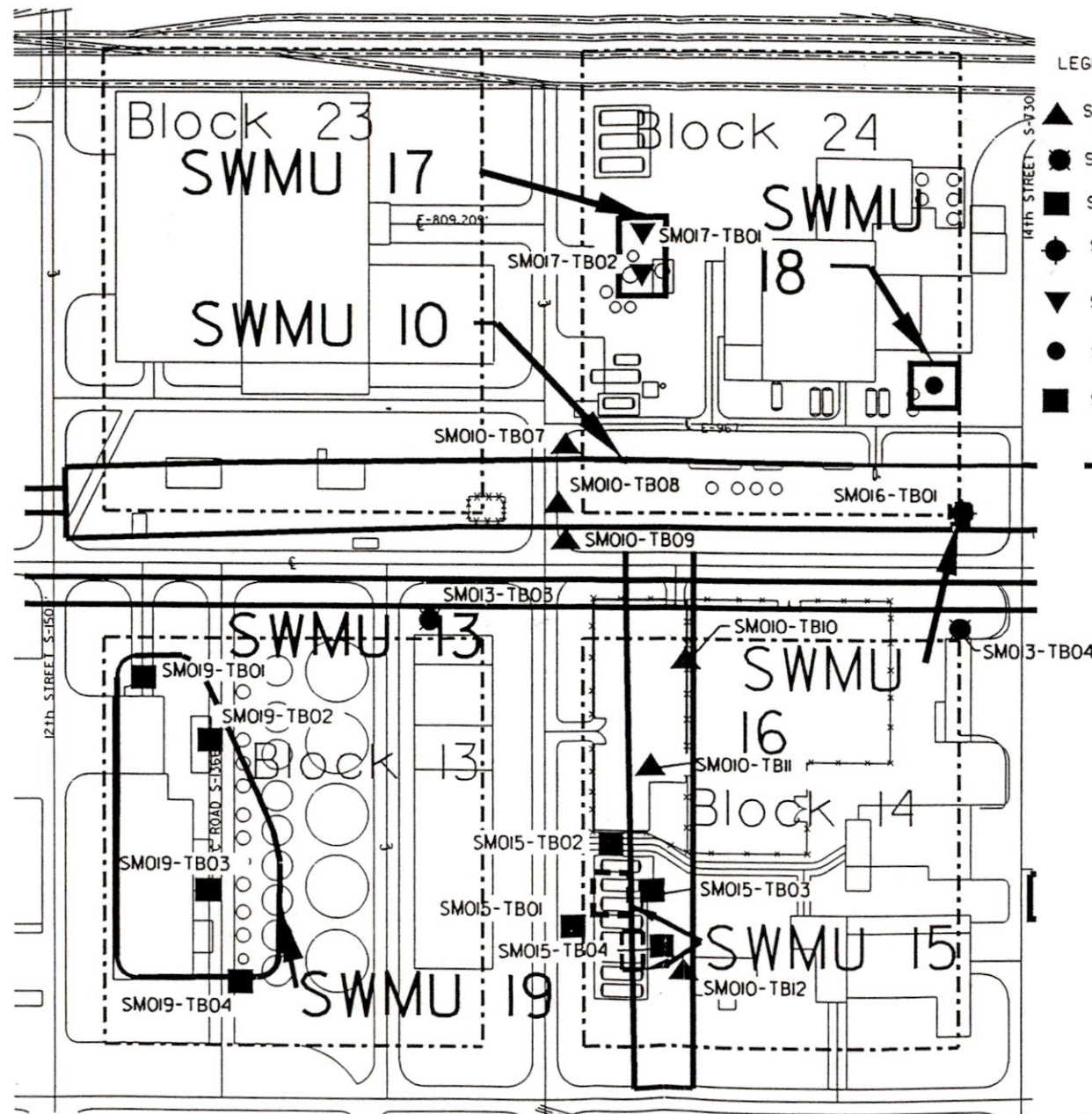
SWMU 9 - Residue Fill Area Unit 3Fe

Three test boring will be installed at SWMU 9 at the locations illustrated in Figure 3-11. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 20 ft-bgs). If the alluvial aquifer water table has not been encountered within the first 20 feet of the boring, the borings will continue to be advanced to the top of the water table. Soil samples will be collected from the borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 9 on Table 3-6.

SWMU 10. Infilled Wastewater Ditch (Former Process Trench)

Four locations along the main former process trench will be investigated using a series of test borings traversing the infilled ditch. At the location of each traverse three test borings will be installed (12 borings in all). One test boring at each traverse will be within the infilled ditch and two borings (one on each side) will be placed outside the ditch. Six additional borings will be installed at the location of infilled secondary (feeder) trenches, which formerly discharged into the main ditch. The locations of the borings are provided on Figures 3-10, 3-11, 3-12, and 3-13.

Each test boring installed within infilled trench limits will be advanced through the fill materials and into underlying natural soil (anticipated to be no deeper than 25 feet-bgs). If the alluvial aquifer water table is not encountered in the first 25 feet, then the test borings will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 10 on Table 3-6.



LEGEND:

- ▲ SWMU 10 PROPOSED TEST BORING LOCATION
- SWMU 13 PROPOSED TEST BORING LOCATION
- SWMU 15 PROPOSED TEST BORING LOCATION
- SWMU 16 PROPOSED TEST BORING LOCATION
- ▼ SWMU 17 PROPOSED TEST BORING LOCATION
- SWMU 18 PROPOSED TEST BORING LOCATION
- SWMU 19 PROPOSED TEST BORING LOCATION

— SWMU BOUNDARY

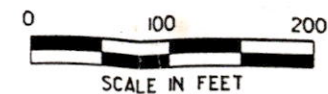


FIGURE 3-12

BAYER CORPORATION
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PITTSBURGH, PA

PROPOSED SAMPLE LOCATIONS-
SWMU 10, 13, 15, 16, 17, 18, AND 19

DATE: 7/17/95

DR.: D.M.

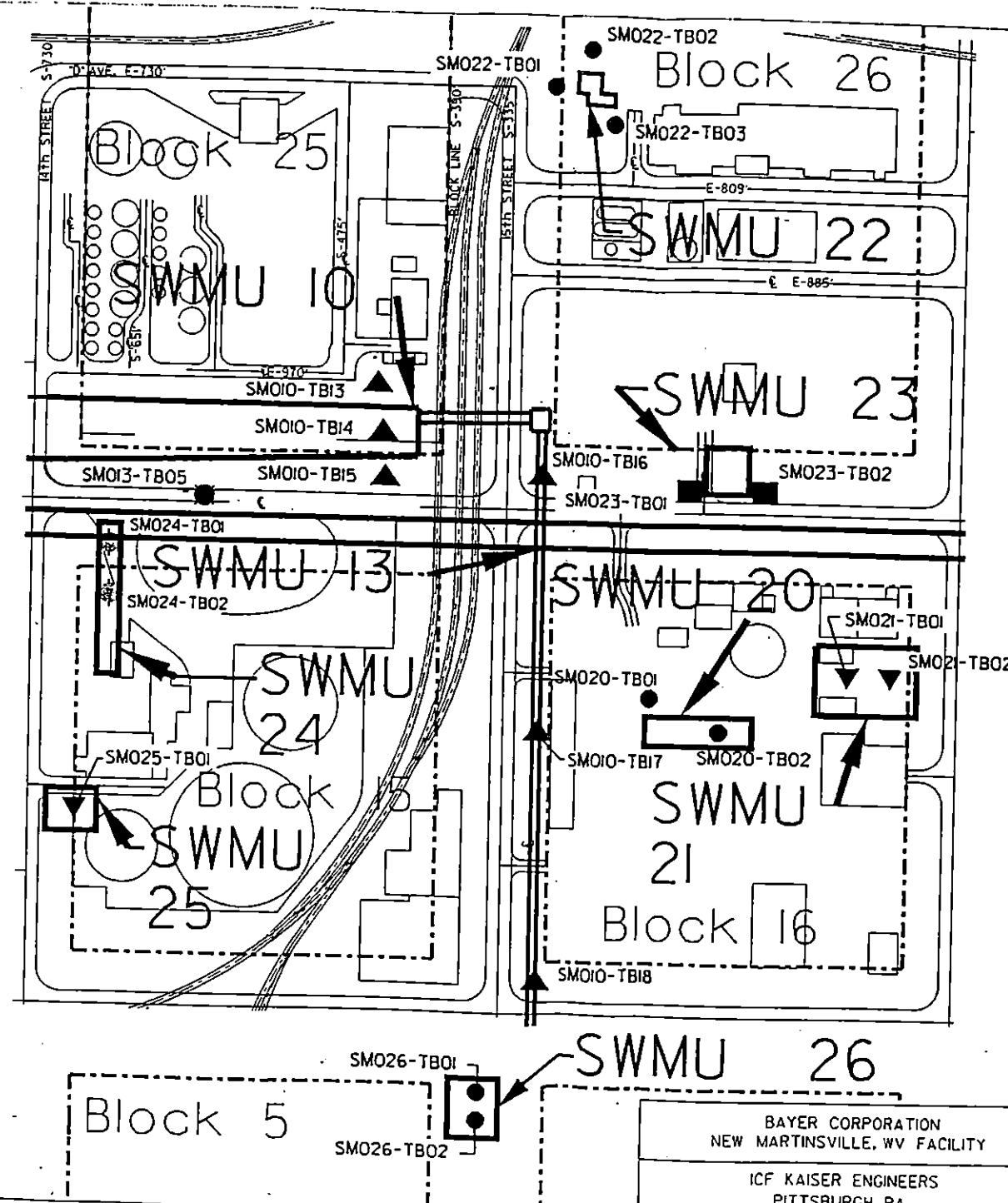
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LEGEND:

- ▲ SWMU 10 PROPOSED TEST BORING LOCATION
- SWMU 13 PROPOSED TEST BORING LOCATION
- SWMU 20 PROPOSED TEST BORING LOCATION
- ▼ SWMU 21 PROPOSED TEST BORING LOCATION
- SWMU 22 PROPOSED TEST BORING LOCATION
- SWMU 23 PROPOSED TEST BORING LOCATION
- ⬢ SWMU 24 PROPOSED TEST BORING LOCATION
- ▼ SWMU 25 PROPOSED TEST BORING LOCATION
- SWMU 26 PROPOSED TEST BORING LOCATION
- SWMU BOUNDARY

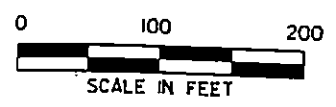


FIGURE 3-13

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		PROPOSED SAMPLE LOCATIONS- SWMU 10, 13, 20, 21, 22, 23, 24, 25, AND 26	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 7/17/95	DR.: D.M.
		SCALE: AS NOTED	DWG. NO. BTBRB05

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SWMU 11. Acid Neutralization Facility 5Fg

One test boring will be installed at SWMU 11 at the location illustrated in Figure 3-11. The boring will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 11 on Table 3-6.

SWMU 12. Former Neutralization Spill Basin

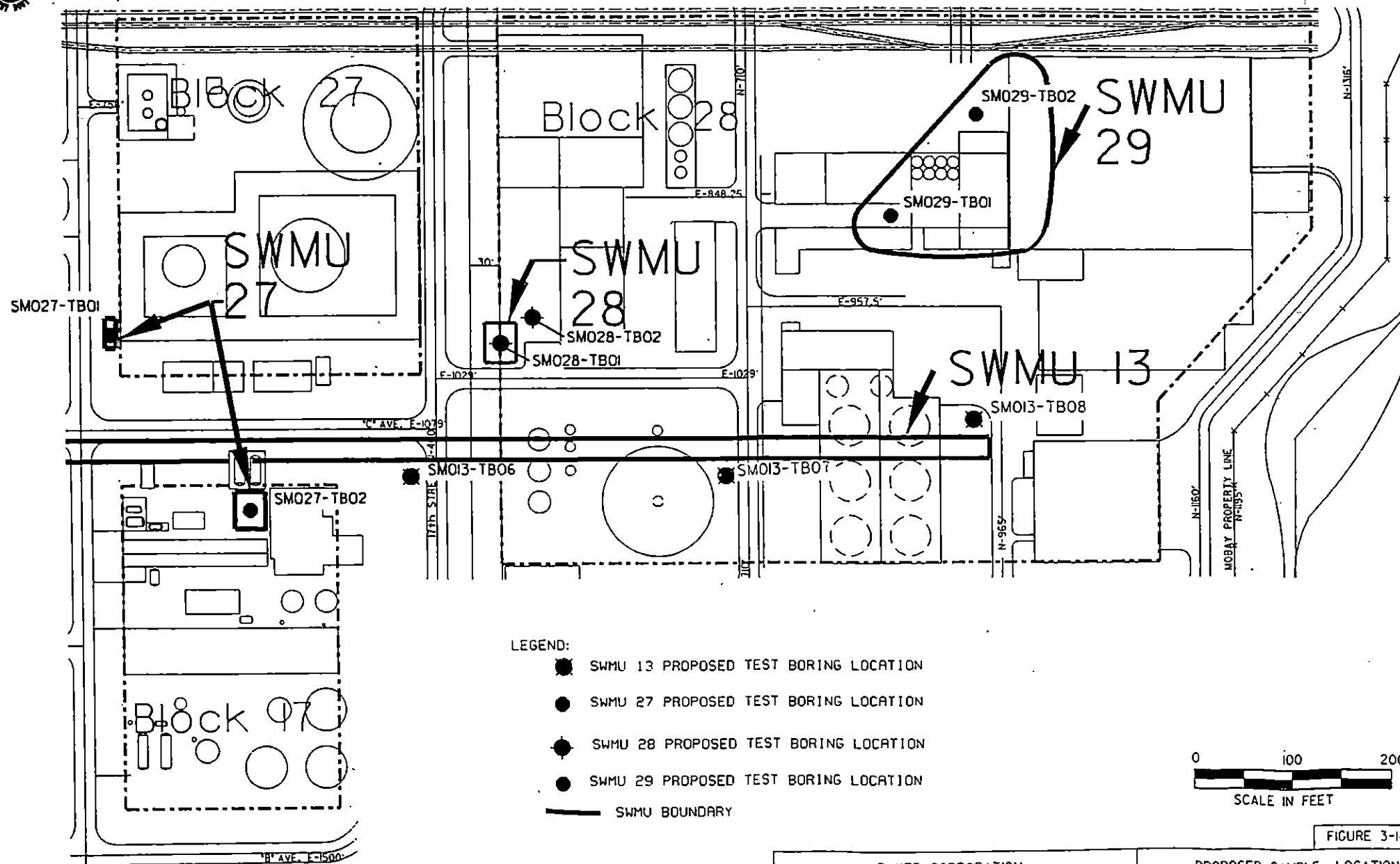
Three test borings will be installed at SWMU 12 at the location illustrated in Figure 3-11. The borings will be advanced until the alluvial aquifer water table is encountered. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 12 on Table 3-6.

SWMU 13. Existing Process Trench

Eight test borings will be installed along the length of the existing process at the locations illustrated on Figures 3-11, 3-12, 3-13, and 3-14. The boring will be advanced to the top of the alluvial. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 13 on Table 3-6.

SWMU 14. Fill Materials Block 11

Three test borings will be installed at SWMU 14 at the location illustrated in Figure 3-11. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 25 ft-bgs). If the alluvial aquifer water table has not been encountered within the first 25 feet of the borings, the boring will continue to be advanced to the top of the water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in



- LEGEND:
- SWMU 13 PROPOSED TEST BORING LOCATION
 - SWMU 27 PROPOSED TEST BORING LOCATION
 - SWMU 28 PROPOSED TEST BORING LOCATION
 - SWMU 29 PROPOSED TEST BORING LOCATION
 - SWMU BOUNDARY

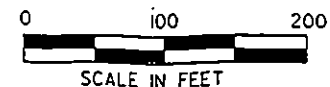


FIGURE 3-14

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		PROPOSED SAMPLE LOCATIONS- SWMU 13, 27, 28 AND 29	
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		SCALE: AS NOTED	DWG. NOBTBR806

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Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 14 on Table 3-6.

SWMU 15. Neutralization and Settling Basin

Four test borings will be installed at SWMU 15 at the locations illustrated in Figure 3-12. The borings will be advanced to the top of the alluvial aquifer water table. Two borings will be placed near the neutralization basin and the other two borings near the settling basin. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 15 on Table 3-6.

SWMU 16. Neutralization Basin 5Fe

One test boring will be installed at SWMU 16 at the location illustrated in Figure 3-11. The boring will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. If oak planks which are reported to have underlain the basin are encountered, in the unsaturated zone one sample will be collected from the soil located immediately beneath the planks. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 16 on Table 3-6.

SWMU 17. Polyol Area

Two test borings will be installed at SWMU 17 to a depth of 5 feet-bgs at the location provided in Figure 3-12. The borings depth is limited to 5 ft-bgs because this was a recent spill (May, 1994) of a small quantity (20 gallons) of TDA that was immediately cleaned up. Two soil samples will be collected from each boring, one at 0 to 0.5 foot-bgs and one 3 to 5 feet-bgs. An additional sample will be collected in the 0.5-foot to 3 feet-bgs interval if elevated OVM readings or evidence of visual contamination are observed. The soil samples will be analyzed for the parameters listed on Table 3-6.

SWMU 18. Lab Area 24A

One test boring will be installed at SWMU 18 at the location illustrated in Figure 3-12. The boring will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 18 on Table 3-6.

SWMU 19. Residue Fill Area 3Fa

Four test borings will be installed at SWMU 19 at the locations illustrated in Figure 3-12. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 20 feet-bgs). If the alluvial aquifer water table has not been encountered within the first 20 feet of the borings, the borings will continue to be advanced to the top of the water table. Soil samples will be collected from the borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 19 on Table 3-6.

SWMU 20. Nitrations Neutralization and Settling Basin 5Fb

Two test borings will be installed at SWMU 20 at the locations illustrated in Figure 3-13. Soil samples will be collected from the borings at this SWMU in accordance with the procedures in Section 3.3.1.1. The borings will be advanced to the top of the alluvial aquifer water table. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 20 on Table 3-6.

SWMU 21. Nitrations Neutralization and Settling Basin 5Fc

Two test borings will be installed at SWMU 21 at the locations illustrated in Figure 3-13. Soil samples will be collected from the borings at this SWMU in accordance with the procedures in Section 3.3.1.1. The borings will be advanced to the top of the alluvial aquifer water table. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 20 on Table 3-6.

SWMU 22. Vortex Burner

The location of the former Vortex Burner is completely covered by the existing TDA production facility; therefore drilling will be limited to the perimeter of the production facility. Three test borings will be installed at SWMU 22 at the location illustrated in Figure 3-13. The boring will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 22 on Table 3-6.

SWMU 23. TDI Area 26B

Two test borings will be installed adjacent to the current concrete pad at SWMU 23 at the locations provided in Figure 3-13. The borings will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the borings at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 23 on Table 3-6.

SWMU 24. Neutralization Trench/Basin 5f-d

Two test borings will be installed at SWMU 24 at the location illustrated in Figure 3-13. The boring will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 24 on Table 3-6.

SWMU 25. HCl Acid Area 15C

One surface soil sample will be collected at the location of a one-foot squared rust colored stain observed at this SWMU (Figure 3-13). The sample will be collected by hand using a stainless steel bucket auger instead of the HSA rig or Geoprobe device because access to the stained area is restricted. In addition, one test boring will be installed to the alluvial aquifer water table as close as practicable to the SWMU to collect subsurface samples. Samples for laboratory analysis will be collected at the depths indicated and parameters listed in Table 3-6.

SWMU 26. Former Waste Disposal Incinerator

Two test borings will be installed at SWMU 26 at the location illustrated in Figure 3-13. The borings will be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 26 on Table 3-6.

SWMU 27. Mononitrobenzene Area

Two test borings will be installed at SWMU 20 at the locations illustrated in Figure 3-14. One test boring will be installed and sampled in each of the two historic mononitrobenzene spill areas. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Each boring will be advanced to the top of the alluvial aquifer water table. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 27 on Table 3-6.

SWMU 28. Iron Oxide Area 28A

Two test borings will be installed at SWMU 28 at the locations illustrated in Figure 3-14. One test boring will be installed at the center of the SWMU and the second in the stained gravel area observed adjacent to the northeast boundary of this SWMU. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. The borings will be advanced to the top of the alluvial aquifer water table. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 28 on Table 3-6.

SWMU 29. Fill Area Block 28

Two test borings will be installed at SWMU 29 at the locations illustrated in Figure 3-14. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 15 ft-bgs). The borings will continue to be advanced to the top of the alluvial aquifer water table. Soil samples will be collected from the boring at this SWMU in accordance with

the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 29 on Table 3-6.

SWMU 30. Residue Fill Area 3Fb

Three test borings will be installed at SWMU 30 at the location illustrated in Figure 3-15. The borings will be advanced through fill materials and into underlying natural material (anticipated to be no deeper than 20 feet-bgs). If the alluvial aquifer water table has not been encountered within the first 20 feet of the boring, the boring will continue to be advanced to the top of the water table. Soil samples will be collected from the boring at this SWMU in accordance with the procedures in Section 3.3.1.1. Samples for laboratory analysis will be collected at the depths indicated and parameters listed for SWMU 30 on Table 3-6.

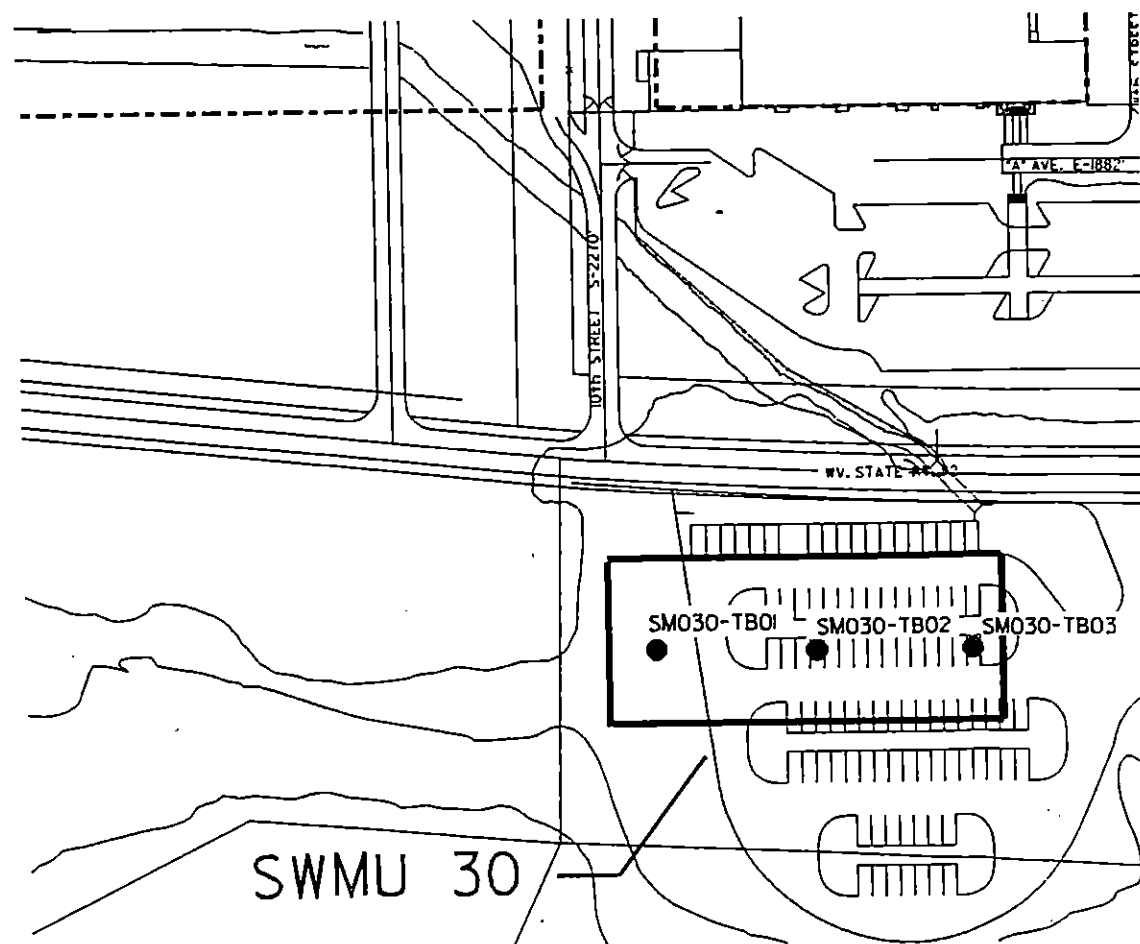
3.3.2 RFI Task 7 - Concrete Sample Collection

Surface concrete samples will be collected at SWMU 3 (Fill Area Hydroblasting Station) and SWMU 28 (Iron Oxide Area 28A). These SWMUs were selected for concrete sampling because they are no longer active and concrete that may have been contaminated by past operations of the SWMU still exists. Concrete chip samples (approximately 5 from each SWMU) will be collected from concrete surfaces of each of the two SWMUs in accordance with the procedures in the QAPP Addendum (Appendix B-1). The chip samples from each SWMU will be composited to form a single sample for each SWMU. Chip sampling will be biased toward areas with visible staining. Concrete samples from each SWMU will be analyzed for the site parameters listed in Table 2-3.

3.3.3 RFI Task 8 - Lagoon Water and Sediment Sample Collection

Ponded water and sediment from SWMU 4 will be collected and sent to the laboratory for analysis. Lagoon water and lagoon sediment samples will be collected in accordance with the procedures in the QAPP Addendum in Appendix B-1. All sediment samples will be screened using an OVM immediately upon retrieval and will be logged using the USCS.

Three surface water samples will be collected from ponded water in SWMU 4 at the locations illustrated in Figure 3-9. One sample will be collected from the northern end of the lagoon, one at



LEGEND

- PROPOSED TEST BORING LOCATION-SWMU 30
- SWMU BOUNDARY

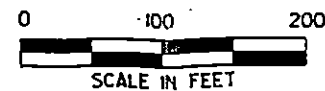


FIGURE 3-15

BAYER CORPORATION NEW MARTINSVILLE, WV FACILITY		PROPOSED SAMPLE LOCATIONS SWMU 30	
ICF KAISER ENGINEERS PITTSBURGH, PA		DATE: 7/17/95	DR.: D.M.
		SCALE: AS NOTED	DWG. NO. 8TBRB07

the center, and one at the southern end. The lagoon water will be collected directly into the sample bottles and the samples will immediately be appropriately preserved in accordance with the procedures in the QAPP. Surface water samples will be analyzed for site analyte list presented in Table 2-3.

Three sediment cores will be collected using a Solonist™ core tube sampler or equivalent at the locations where surface water samples were collected. The solonist sampler will be used to obtain a core (typically 5-foot length). After retrieving the core, it will be opened and screened with an OVM. The amount of recovery will be noted and the stratigraphy and other observations (i.e. visual contamination) will be recorded. One sample at each location will be collected from the surface of the sediments (0 to 0.5 ft-bgs), and the second sample will be taken from the deepest recovered portion of the core. A third sample will be submitted from the section in between the shallow and deep sediment sample if elevated OVM readings or evidence of visual contamination is present. Sediment samples will be analyzed for the site parameters listed in Table 2-3.

3.4 PHASE 3 DATA COLLECTION

Phase 3 sample collection will define the nature and extent of contamination identified during Phase 2 as potentially presenting a risk to human health or the environment. SWMUs which were found to pose the greatest potential risk to human health and the environment during the Phase 2 risk assessment, will receive highest priority during the Phase 3. Soil samples will be collected at the surface and subsurface from SWMUs included in Phase 3 such that the lateral and vertical limits of contamination posing risk to human health or the environment is fully defined and the data needs for the CMS are completely addressed. Any data gaps remaining for lagoon water and sediment sampling or concrete sampling will also be addressed during Phase 3. In addition, Phase 3 will include a plan for investigating surface water and sediments if warranted by Phase 2 findings. Details of the Task 8 sampling program including locations and analytes will depend completely on Phase 2 results and will be provided when the Phase 3 scope of work is formulated. It is anticipated that samples collected at SWMUs (or SWMU groups) during Phase 3 to define extent will be analyzed for only those constituents detected in Phase 2.

4.0 PROJECT MANAGEMENT PLAN

The following sections describe the project organization, the responsibilities of the various parties involved with the project, the planning and control procedures to be used to manage the project, and the project schedule for the RFI.

4.1 PROJECT ORGANIZATION

The project organization presents the various parties to be involved in conducting the RFI and describes the role that each will play during the project. The following sections present the general organization to be used for planning and implementation of the RFI.

4.1.1 Bayer Corporation

Bayer will designate a project manager for the RFI to be conducted at the New Martinsville plant. The Bayer project manager will act as a contact with the EPA for all matters concerning the RFI and shall be the agent for the purpose of service for all matters concerning the RFI. Ms. Mary Ann Henderson, (304) 455-4400, will act as Bayer Project Manger during the RFI.

4.1.2 Prime Contractor

ICF Kaiser Engineers, Inc. (ICF Kaiser) of Pittsburgh, Pennsylvania has been contracted by Bayer to serve as the prime contractor for implementation of the RFI at the New Martinsville plant. The prime contractor will assist Bayer in the RFI planning, field operations, laboratory management, and reporting. In this capacity, ICF Kaiser will develop and implement RFI field procedures, conduct all field sampling, perform risk assessment activities, evaluate sample data and prepare reports. ICF Kaiser will also assist in developing health and safety requirements and procedures for RFI field activities, in ensuring that proper quality assurance procedures are followed throughout the project, and in supervising subcontractors during the project.

4.1.3 Laboratory Services Contractor

The laboratory services contractor for the New Martinsville plant RFI will be responsible for analysis of samples collected during the project. The laboratory will be responsible for all bench-level QA/QC, data reduction, data reporting, and analytical performance monitoring. The Bayer New Martinsville Laboratory will be the laboratory services contractor during the New Martinsville RFI.

4.1.4 Other Subcontractors

The activities to be conducted during the RFI will require the services of various specialty subcontractors. Activities such as advancement of soil borings will require the services of a qualified, competent drilling contractor. A licensed surveyor will be required to accurately locate sampling points and monitoring well locations during the RFI. In addition, since soil gas sampling is to be performed, a qualified contractor may be required to install soil gas sample extraction points or to perform analysis of the resulting samples. The drilling, surveying, and soil gas sampling subcontractors will be under the direct supervision of Bayer's prime contractor during the RFI. These specialty contractors will be determined following acceptance of the RFI work plan by EPA.

4.2 PROJECT RESPONSIBILITIES

The various parties identified in Section 4.1, Project Organization, will be responsible for different aspects of the RFI project. The following sections present the key personnel and responsibilities for each party.

4.2.1 Prime Contractor Personnel

ICF Kaiser Engineers will be responsible for planning, implementing, and reporting the RFI activities. The key ICF Kaiser personnel and their responsibilities are described below:

ICF Kaiser Project Manager, Mr. Douglas B. Taylor, P.E.: (Telephone 412/497-2331).

The project manager assumes overall responsibility for project quality and is the interface between project staff, Bayer, EPA, and the corporate QA and health and safety organizations. The project manager has the authority and responsibility to implement corrective actions based on findings or recommendations from the Bayer project manager, the QA director, the health and safety officer or the EPA oversight staff for the New Martinsville RFI. The project manager will be responsible for developing project procedures and for scheduling and assigning personnel to field tasks to best meet project needs. The project manager is the only person who can approve major changes to the sampling plan (with prior approval of Bayer and EPA). He also has the authority to require corrective action by subcontractors for work not performed in accordance with project specific procedures.

ICF Kaiser QA Officer, Mr. Richard McCracken: (Telephone 412/497-2380).

The QA director reports to the project manager through a chain of command that is separate from the project staff to avoid conflicts of interest. The QA director will be responsible for field sampling system audits, analytical subcontractor surveillance and data validation supervision. The QA director has full authority to require corrective action when field operations are not in compliance with the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP). He has the authority to advise the project manager when subcontractor performance is not in accordance with the QAPP.

ICF Kaiser Health and Safety Officer - Mr. Daniel Welshons: (Telephone 412/497-2329)

The health and safety officer is responsible for health and safety issues during project activities. The health and safety officer will ensure that the project meets all appropriate health and safety standards and that all RFI activities are performed in accordance with the Health and Safety Plan developed for this project.

ICF Kaiser RFI Task Manager - Mr. Mark Portman, C.P.G.: (Telephone 412/497-2396)

The RFI task manager will manage the data collection and assessment phase of work for the New Martinsville plant RFI. The task manager will be responsible for ensuring that the field operations

lead obtains the resources, sampling equipment and laboratory support necessary to perform the scope of work. The RFI task manager also assists the risk assessment task manager during identification and assessment of the potential exposure scenarios. The RFI task manager reports directly to the project manager.

ICF Kaiser Risk Assessment Task Manager - Mr. Jeff Smith: (Telephone 412/497-2341)

The project risk assessment (RA) task manager will be responsible for ensuring that data needs identified during the initial project phases are addressed during the RFI. The RA task manager will also be responsible for ensuring that all source/receptor pathways of concern are characterized and evaluated, and that the public health and environmental risks identified during the RFI will be properly evaluated and reported. The RA task manager reports directly to the project manager.

ICF Kaiser RFI - Field Operations Lead - To Be Determined

The field operations lead (FOL) is responsible for coordinating and directing the technical efforts of the project staff and subcontractors during RFI field investigation activities. The FOL is responsible for transmitting the project procedures, health and safety protocols, and QA/QC requirements to the field staff and subcontractors prior to the initiation of work. The FOL also provides instruction to all field personnel to ensure that field data are collected in conformance with project QA/QC requirements as specified in the RFI QAPP. It is the FOL's responsibility to mobilize the appropriate sampling and monitoring equipment, ensure that field control samples are collected as required, maintain chain of custody, and complete proper field documentation. The FOL has full authority over logistical aspects of sampling in the field and is responsible for identifying the resources necessary to meet the intended schedule.

ICF Kaiser Project Staff

The project staff will be responsible for supervising the drilling subcontractor during the installation of monitoring wells, classifying lithology samples and determining well depths in the field. They will also supervise soil gas sampling activities and soil boring activities. In addition, project staff will assist the project manager, RFI task manager, and RA task manager in the performance of their duties. Project staff are assigned on a project-specific basis.

4.2.2 Laboratory Personnel

The Bayer New Martinsville Environmental Testing Services (ETS), which is managed by Dr. Richard H. Ode, will provide the analytical laboratory services during the New Martinsville facility RFI. The laboratory organization and responsibility are included in Section 4 of the Bayer ETS QA/QC Manual, which is Appendix A of the RFI work plan QAPP (ICF Kaiser, 1995b).

4.2.3 Drilling Subcontractor Personnel - To be Determined

The drilling subcontractor will be determined following acceptance of the RFI work plan by EPA. The drilling subcontractor will follow the direction of the prime contractor and will be subject to the planning and control procedures outlined in Section 4.3.

4.2.4 Survey Subcontractor Personnel - To be Determined

The survey subcontractor will be determined following acceptance of the RFI work plan by EPA. The survey subcontractor will follow the direction of the prime contractor and will be subject to the planning and control procedures outlined in Section 4.3.

4.2.5 Soil Gas Sampling Subcontractor Personnel - To be Determined

The soil gas sampling subcontractor will be determined following acceptance of the RFI work plan by EPA. The soil gas subcontractor will follow the direction of the prime contractor and will be subject to the planning and control procedures outlined in Section 4.3.

4.3 PROJECT PLANNING AND CONTROL

Project planning and control procedures will be developed and implemented to ensure the New Martinsville plant RFI is performed in a proper, efficient, and cost effective manner. The following sections describe the general planning and control procedures that will be used to plan, monitor, analyze, and control the RFI activities.

4.3.1 Project Chain of Authority

The project chain of authority assigns the authority and reporting organization for the project. The chain of authority for the New Martinsville plant RFI is presented in Figure 4-1. The roles of the parties shown in Figure 4-1 are presented in Section 4.2 and their respective authorities are presented in the following sections:

Bayer Project Manager

The Bayer project manager has authority over all phases of the RFI planning and implementation. In this capacity, the Bayer project manager interacts with EPA and WVDEP and reviews and approves all RFI activities and report submittals.

Prime Contractor

The prime contractor acts as Bayer's agent during the development and implementation of RFI procedures and activities. The prime contractor is responsible for ensuring that all activities are performed in accordance the RFI work plan, QAPP, and HASP. The prime contractor reports directly to Bayer and provides oversight of all sample analysis activities performed by the laboratory services contractor. In addition, the prime contractor supervises activities performed by the drilling, surveying, and soil gas sampling subcontractors.

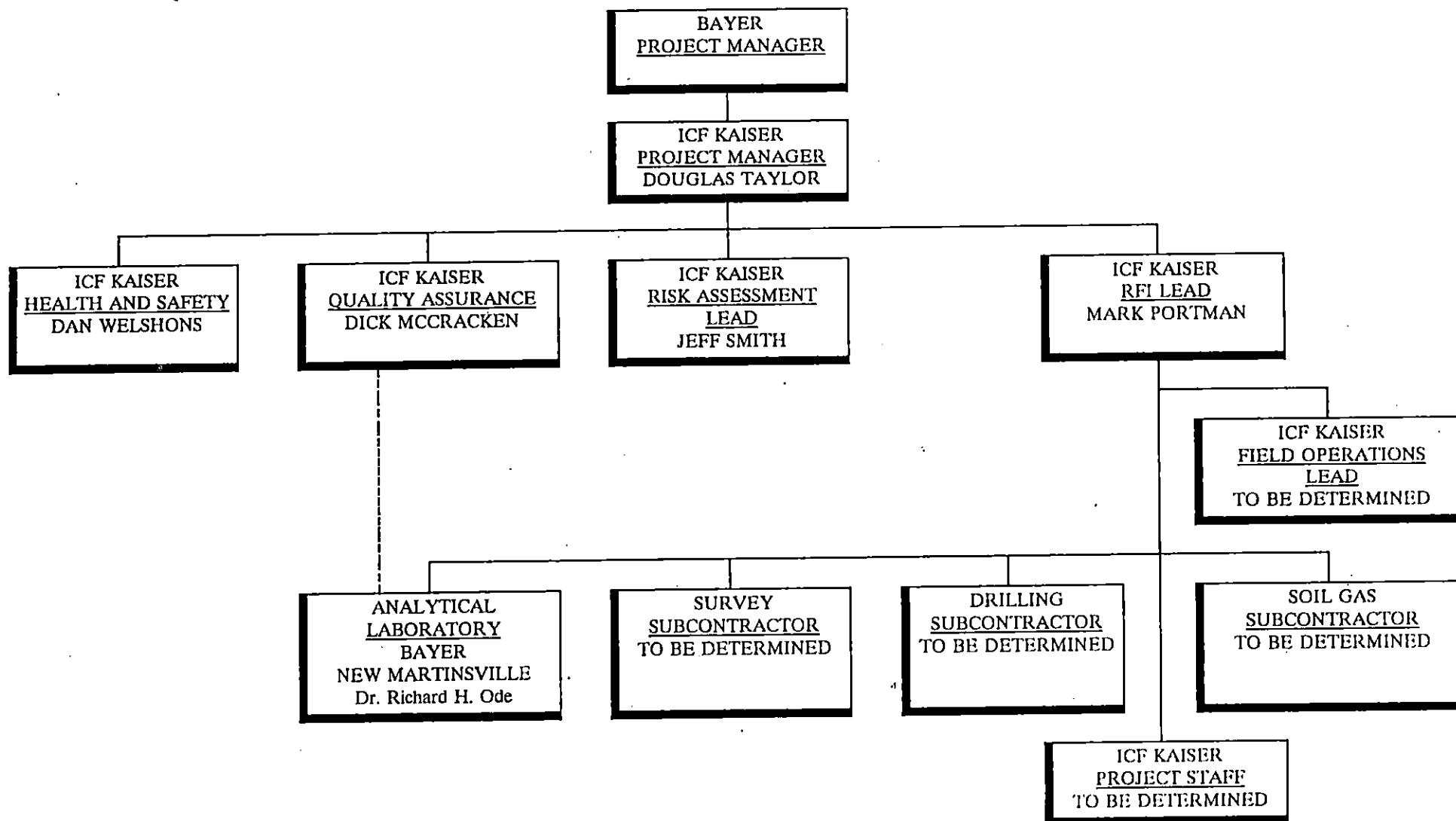
Laboratory Services Contractor

The laboratory services contractor is responsible for analysis of samples collected during RFI field activities. The laboratory services contractor reports to the Bayer project manager and the prime contractor.

Subcontractors

Subcontractors will provide specialty services for drilling, surveying and soil gas sampling during RFI field activities. These subcontractors will report directly to the prime contractor.

FIGURE 4-1
PROJECT ORGANIZATION



4.3.2 Data Management Procedures

Various types of data will be generated during the New Martinsville RFI and this data will be utilized to perform different project tasks. In order to ensure that the data used is consistent among all tasks, detailed data management procedures have been developed. All management of data collected or generated during the New Martinsville plant RFI must be done in accordance with the Data Management Plan (DMP) (ICF Kaiser, 1995c) approved by EPA August 7, 1995.

4.3.3 Quality Assurance Procedures

Quality data is essential during the performance of the New Martinsville RFI. Data generated during the RFI must be collected and evaluated in accordance with the procedures presented in the Quality Assurance Project Plan (QAPP) (ICF Kaiser, 1994b) approved by EPA August 7, 1995 and the QAPP Addendum/Revisions in Appendix B of this document.

4.3.4 Health And Safety Procedures

All field activities must be performed in accordance with the Health and Safety Plan (HASP) presented in Section 6.

4.3.5 Community Relations

Any interaction regarding the Bayer New Martinsville RFI with outside parties not associated with the RFI must have the approval of Bayer and must be done in accordance with the Community Relations Plan presented in Section 5.

4.3.6 Documentation Procedures and Submittals

Activities conducted during the New Martinsville plant RFI will be documented in accordance with the guidelines and procedures presented in this RFI work plan. Field data and observations, sample chain of custody, sample analysis, and data validation activities must be documented in accordance with the procedures presented in Section 3 (the FSP) and the QAPP. Health and safety issues will

be documented in accordance with the procedures presented in the HASP. All such documentation will be kept as part of the permanent project files.

In addition to the documentation procedures just described, various reports will be prepared to document the progress of the project and report the results of the RFI. These progress reports are described below:

Biweekly Field Activity Reports

Reports will be prepared on a biweekly basis by the prime contractor to document the progress of field activities and to identify major or significant events during such activities. These reports will be kept as part of the project file.

Monthly Progress Reports

A monthly report that summarizes the weekly field activity reports and that describes the major activities, issues, and milestones achieved during the RFI for that respective month will be prepared by the prime contractor and submitted to Bayer. Bayer will use these monthly reports to prepare a monthly progress report for submission to the EPA in accordance with the requirements of the RFI process.

Preliminary RFI Report

A preliminary RFI report will be prepared that presents the procedures, data, and results of the New Martinsville plant RFI. This report will also provide recommendations for corrective measures should major environmental issues be identified. The report will be prepared by the prime contractor and reviewed by Bayer. Comments from Bayer will be addressed and incorporated into the RFI report, when appropriate, and the preliminary RFI report will be submitted by Bayer to the EPA for review.

Final RFI Report

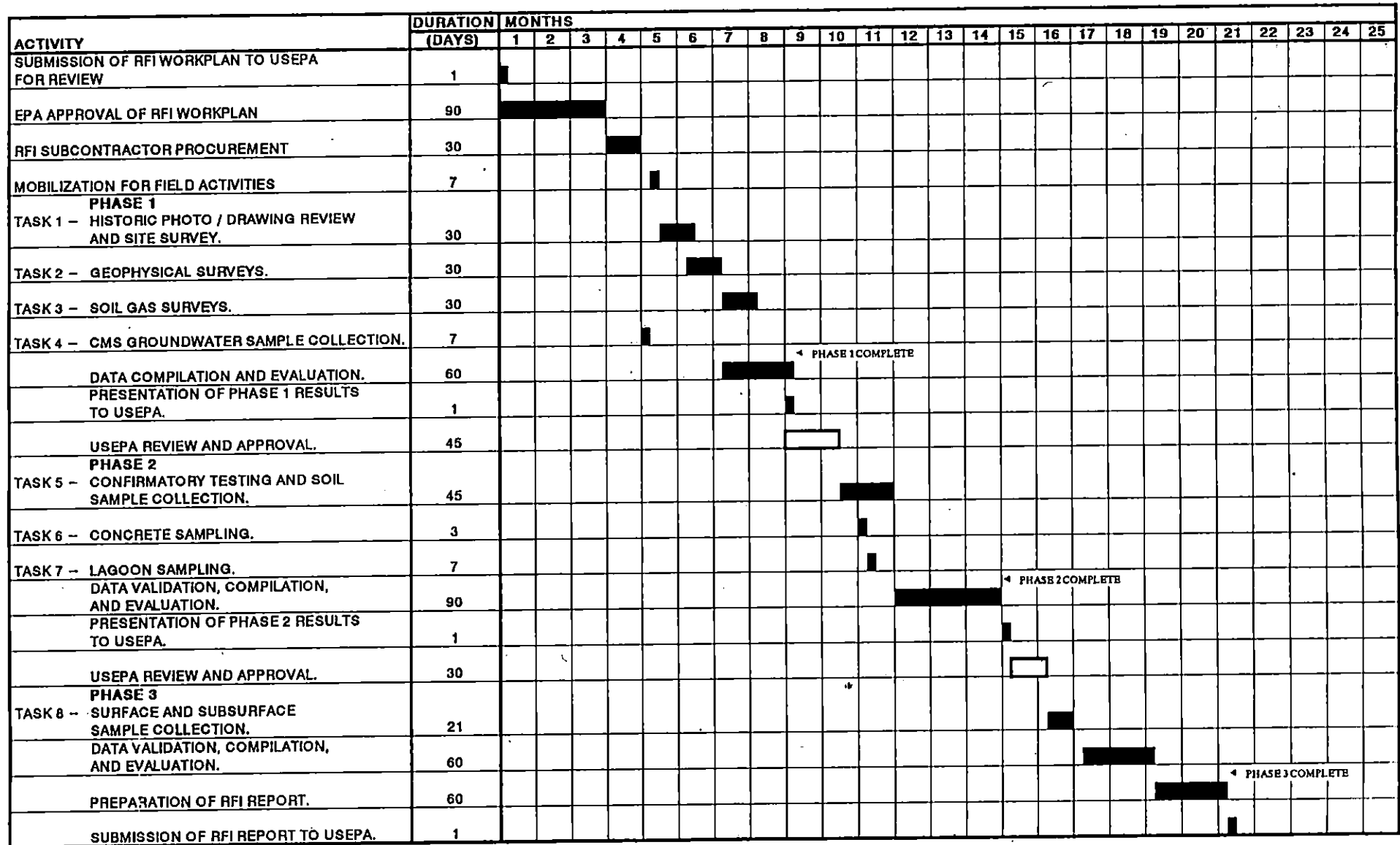
Comments on the Preliminary RFI Report from the EPA will be addressed by Bayer and the prime contractor. Upon approval of any necessary response to EPA comments, the appropriate corrections,

additions, and/or clarifications will be made to the report and a final RFI report will be submitted to EPA for approval.

4.4 PROJECT SCHEDULE

The schedule for implementation and completion of the New Martinsville RFI is presented in Figure 4-2.

**FIGURE 4-2
BAYER NEW MARTINSVILLE RFI PROJECT SCHEDULE**



5.0 COMMUNITY RELATIONS PLAN

5.1 PURPOSE

This Community Relations Plan (CRP) has been prepared for guidance in disseminating information regarding the RFI conducted at the Bayer New Martinsville Plant located in Marshall and Wetzel Counties, West Virginia. The CRP provides a brief discussion of the following:

- Community background
- Project contact
- Preparation and distribution of information materials
- Participation in community meetings
- Progress reporting requirements

5.2 COMMUNITY BACKGROUND

The Bayer property is located in southern Marshall County and northern Wetzel County along the eastern bank of the Ohio River. The processing facility and all SWMUs are located in Marshall County. Bayer's property within Wetzel County is not developed.

The area is sparsely populated with approximately 550 residents living within a four-mile radius of the plant. Land use in the nearby vicinity of the Facility is primarily devoted to industry with plants owned by PPG Industries, Inc. (PPG), Ormet, CONALCO, and Air Products and Chemicals, Inc. in operation along both sides of the Ohio River. These plants, including the Bayer Plant, are also the major employers in the area, employing approximately 4,700 people.

The closest residences to the Facility are in the unincorporated community of Proctor, bordering the Facility on the south. This community has approximately 80 residents. Other nearby communities include unincorporated Kent, West Virginia and the Village of Clarington, Ohio. Kent has approximately 40 residents and is located north of the Facility while Clarington has approximately 500

residents and is situated northwest of the Facility on the opposite side of the Ohio River. The village of Clarington is governed by a Mayor and Village Council with the assistance of a Village Clerk.

The Facility lies between the two larger communities of Moundsville and New Martinsville. Moundsville is approximately 17 miles to the north of the Facility and is the county seat of Marshall County. New Martinsville is approximately 5 miles to the south of the Facility and is the county seat for neighboring Wetzel County. As of the 1990 Census, the populations of Moundsville and New Martinsville were 10,753 and 6,705, respectively. Moundsville operates on a city manager form of government, while New Martinsville uses the strong mayor/city council model. County-wide, the populations of Marshall and Wetzel are 37,356 and 19,258, respectively. Both counties are governed by a board of commissioners, each containing three commissioners.

5.3 PROJECT CONTACT

A project contact has been established to answer questions from interested parties. This person is:

Ms. Mary Ann Henderson
Superintendent, Regulatory Affairs
Bayer Corporation
State Route 2
New Martinsville, West Virginia 26155
(304) 455-4400

The name of the project contact has been supplied to the WVDEP, local officials, and the EPA Region III. The contact person also will be mentioned in plant publications and informational materials prepared for the project. In addition, local media contacts will be provided with the above information in the event that local newspapers want to contact a plant representative for information on the RFI.

5.4 PREPARATION AND DISTRIBUTION OF INFORMATIONAL MATERIALS

Bayer will use existing publications and develop fact sheets for distributing information about the RFI to the community. The plant currently prepares a newsletter on a quarterly basis, called the *Bayer*

New Martinsville Newsletter for employees and retirees. Bayer also makes available to its employees the *Green Team News*, a bimonthly newsletter. The newsletters will be used as necessary to distribute information on the project. In addition, fact sheets will be prepared as needed to keep the community up-to-date on the project. These fact sheets will be distributed to local, state, and federal officials and other interested parties through a mailing list developed for the project. The mailing list will include, but will not be limited to, officials with regulatory agencies, such as WVDEP, EPA, and Ohio River Sanitation Commission (ORSANCO).

Should press releases be necessary, Bayer also will distribute press releases to local newspapers and other media outlets, including, but not limited to the following: WTRF-Channel 7 News (CBS affiliate), the *Wheeling News Register and Intelligencer*, the *Moundsville Echo*, the *Wetzel Chronicle*, the *Tyler Star-News*, and the *Monroe Co. Beacon*. Press releases regarding the project will be distributed during RFI milestones to announce such events as EPA's approval of the RFI Work Plans, start of work, and the results and completion of the RFI.

5.5 COMMUNITY MEETINGS

Local officials including mayors, councilpersons, and commissioners of nearby communities and counties will be invited to attend presentations given by Bayer officials at Local Emergency Planning Committee (LEPC) and Community Advisory Panel (CAP) meetings. The LEPC consists of emergency coordinators from Marshall and Wetzel counties, first responders, industry representatives, and other local officials. The committee, which is concerned with emergency preparedness, meets periodically as needed. The CAP is an organization founded by Bayer and PPG and consists of 16 community members, who meet monthly to discuss issues of mutual interest to the community, Bayer, and PPG.

In addition, Bayer will attend public meetings as requested by EPA Region III personnel and local officials. For these meetings, fact sheets and other informational materials will be made available to the attendees. Beside updating attendees on the progress at the site, ample time will be set aside at each meeting to answer questions from the audience.

5.6 PROGRESS REPORTS

Progress reports will be issued by Bayer by the twentieth of each month for the preceding month's activities. The progress reports will be transmitted to the EPA Region III. The EPA will make the information contained in these progress reports available to the public. The reports will contain the following information:

- A description and estimate of the percentage of the RFI completed
- Summary of findings
- Summaries of changes made in the RFI during the reporting period
- Summaries of contacts with representative of the local community, public interest groups, or state government during the reporting period
- Listing of public affairs efforts including press releases, public notices, meetings, and public service announcements
- Summaries of problems or potential problems encountered during the reporting period
- Actions taken to rectify the problems.

6.0 REFERENCES

- EPA (Winett, H.). 1986. USEPA Consent Order RCRA-III-004-AM.
- EPA (Wassersug, S.). 1987. "HWA Solid Waste Permit - West Virginia RCRA Permit WVD 05 686 6312."
- EPA. 1989a. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. OSWER Directive 9285.7-Ola. September.
- EPA. May 1989a. "RCRA Facility Investigation Guidance." Volumes I-IV. Washington.
- EPA. 1989b. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/8-89/043. May.
- EPA. 1989c. Risk Assessment Guidance for Superfund, Volume II. Environmental Evaluation Manual. Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/001.
- EPA. 1989d. "Interim Final RCRA Facility Investigation (RFI) Guidance. EPA/530/SW-89-031."
- EPA. 1991a. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." Office of Solid Waste and Emergency Response. OSWER Directive 9285.6-03. March 25, 1991.
- EPA. 1991b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. (Part B, Development of Risk-based Preliminary Remediation Goals) (Interim). Office of Emergency and Remedial Response. Publication 9285.7-01B. December 1991.
- EPA. 1991c. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Don R. Clay, Assistant Administrator. OSWER Directive 9355.0-30. April 22.
- EPA. 1992a. Supplemental Guidance to RAGS: Calculating the Concentration Term. Office of Solid Waste and Emergency Response. Publication 9285.7-081. May
- EPA. 1992b. Framework for Ecological Risk Assessment. Risk Assessment Forum, Washington, DC. EPA/630/R-92/001.
- EPA (Zielinski, D.). 1995. "Description of Current Conditions Approval EPA ID No. WVD 056 866 312."
- EPA Region III. Undated. RCRA Facility Investigation/Corrective Measures Study Ecological Assessment Guidance Document, First Edition. Hazardous Waste Management Division, Office of RCRA Programs.
- EPA Region III. 1994. Interim Ecological Risk Assessment Guidelines. Technical Support Section, Superfund Program Branch, Hazardous Waste Management Division. July 27.

EPA Region III. 1995. Risk-based Concentration Table, January - June 1995. Roy L. Smith, Technical Support Section. March 7.

Federal Register. July 27, 1990. 55 (145) 30798-30884.

ICF Kaiser Engineers, Inc. 1995a. "Description of Current Conditions, Bayer, New Martinsville, West Virginia."

ICF Kaiser Engineers, Inc. 1995b. "Quality Assurance Project Plan, Bayer, New Martinsville, West Virginia."

ICF Kaiser Engineers, Inc. 1995c. "Data Management Plan, Bayer, New Martinsville, West Virginia."

ICF Kaiser Engineers, Inc. 1995d. "Pre-Investigation Evaluation of Potential Corrective Measures Technologies, Bayer, New Martinsville, West Virginia."

IT Corp. 1988a. "RCRA Facility Assessment Report, Mobay Corporation, New Martinsville, West Virginia."

IT Corp. 1988b. "Flood Release Study Report Revised Implemented, Mobay Corporation, New Martinsville, West Virginia."

IT Corp. 1988c. "Revised Existing Process Trench Study, Mobay Corporation, New Martinsville, West Virginia."

Miles, Inc. (Owens, D.). 1993. "EPA - RFI Status (Personal Communication)."

Mobay Corporation. 1988a. "Description of Storm Sewer System, Mobay Corporation, New Martinsville, West Virginia."

Mobay Corporation (Owens, D.). 1988b. "Air Monitoring Phase I Revised (Personal Communication)."

APPENDIX B

APPENDIX B-1: QAPP ADDENDUM
APPENDIX B-2: RESPONSE TO COMMENTS
APPENDIX B-3: QAPP REVISIONS

APPENDIX B

Appendix B contains both addenda and revision to the Bayer RFI Quality Assurance Project Plan dated February 27, 1995. These addenda and revisions are based on EPA's review of the QAPP. Specifically, this Appendix contains:

- Appendix B-1; QAPP Addendum - The RFI QAPP Addendum contains standard operating procedures (SOPs) there were not included in the original QAPP but are needed based on the current scope of the RFI work plan.
- Appendix B-2; QAPP Response to Comments - Appendix B-2 contains a summary of EPA's comments (EPA letter to Bayer dated August 7, 1995) on the QAPP and Bayer's responses to the comments.
- Appendix B-3; QAPP Revisions - Appendix B-2 contains all pages of the QAPP that were revised to address EPA's comments in Appendix B. If there was no change to a page, it is not included in Appendix B-3. Revisions to the text are highlighted where text was added. Where text was deleted, no highlighting is providing.

Upon EPA's approval of the enclosed QAPP Addendum (Appendix B-1), QAPP Response to Comments (Appendix B-2), and QAPP Revisions (Appendix B-3), the entire QAPP will be republished by Bayer. The republished QAPP will be a stand alone document that will incorporate the February 1995 version of the QAPP and these additions/changes into a final project document. Highlighting will be removed from revised pages for the final version. The final QAPP will be sent to all appropriate parties and the February 1995 version and this Appendix B will be removed from the RFI Work Plan.

APPENDIX B-1

QAPP ADDENDUM

- **STANDARD OPERATING PROCEDURES FOR EM SURVEYS, CONCRETE SAMPLE COLLECTION, SURFACE WATER/SEDIMENT SAMPLE COLLECTION**
 - **BAYER ETS PROCEDURES FOR TDA AND TDI EXTRACTION ANALYSIS**
 - **BAYER ETS SCREENING METHOD FOR TDI**
-

STANDARD OPERATING PROCEDURES

- **EM SURVEYS**
 - **CONCRETE SAMPLE COLLECTION**
 - **SURFACE WATER/SEDIMENT SAMPLE COLLECTION**
-

APPENDIX B-1

This Quality Assurance Project Plan (QAPP) Addendum presents information on sample collection methods and procedures not contained in the original QAPP. Four data collection methods: Electromagnetic Induction (EM) Survey, Concrete Chip, Lagoon Sediment, and Surface (Lagoon) Water Sample Collection are discussed in the following subsections. In addition, Bayer Environmental Testing Services (ETS) procedures for TDI and TDA extraction and analysis and TDI screening are included in the addendum.

1.0 ELECTROMAGNETIC INDUCTION (EM) SURVEYS

Scope and Application

Electromagnetic Induction (EM) surveys provide subsurface information and aid in site characterization and detection of landfill and former surface impoundment boundaries and subsurface metallic targets, such as tanks, trenches and pipes. All EM investigations will be conducted by a qualified professional geophysics.

EM measurements of subsurface conductivity can be used to detect and approximate the extent of subsurface contaminants and metal objects. EM measurements may also be used to determine depth to the water table and structural characteristics of the subsurface environment. Conductivity is a function of the geohydrologic section and is overwhelmingly influenced by the presence of water. Therefore, conductivity can provide indirect evidence on the porosity and permeability of subsurface materials and the degree of saturation. These parameters, in turn, are directly related to subsurface lithology and to the potential for infiltration/migration of contaminants from a source area. Conductivity is also influenced by the presence of dissolved electrolytes in soil or rock pore fluids. Contaminant plumes in the vadose (unsaturated) and saturated zones can be mapped, therefore, if there are sufficient conductivity contrasts.

Equipment

The Geonics EM31-DL (or similar instrument) will be used to collect the field data. The data will be digitally stored during data collection and down loaded in the field to a portable computer for data analysis and processing. A portable printer will be used for plotting EM profiles.

Procedures

1. EM measurements will be taken along profiles in the areas specified in the work plan and at discrete spacings along each profile.
2. Measurements will be collected in the vertical dipole mode for a maximum investigation depth of 18 feet or in the horizontal mode for a maximum depth of 10 feet.
3. Both the Quadrature-phase (conductivity) and in-phase (more sensitive to the detection of metal) components of the EM spectrum will be collected.
4. EM instruments are calibrated by the manufacturer over massive rock outcrops of known characteristic that are used as a geologic standard to measure the absolute conductivity over a uniform section of earth. The EM apparatus should be maintained in calibration by the user by noting drift in the readings at a stable "secondary standard" site. A secondary standard site is a location established in the field that is used to check the accuracy (calibration of the instrument and the drift precision of the instrument).

Unacceptable drift or erratic operation shall be corrected by replacement with an instrument in proper working order. Values that are obtained from measurements over the stable secondary standard site that vary by more than 10-15% are considered to be unacceptable drift.

5. Repeated periodic measurements (at least three times a day) should be made at one or more locations and orientations at the site to determine the precision of measurements and to detect instrument drift.

6. Large masses of buried metal, fences, railroad tracks and underground pipes or cables can strongly distort measurements and reduce instrument sensitivity to features of interest. These problems generally can be accounted for or overcome but must be recognized early in the program so that appropriate avoidance measures can be implemented. Known or suspected sources or interference should be accounted for and their effect measured during the investigation.
7. General - Information obtained during an EM survey should be presented according to a standard data format using standardized data sheets with original field entries. As a minimum, this should include the following information:
 - Project, task, site, and location identification;
 - Company or organization;
 - Date (and time, if applicable);
 - Operator's name and signature;
 - Method/technique identification;
 - Instrument make, model, serial number, and calibration date/frequency (if applicable);
 - Coil type and configuration;
 - Line or site grid location(s);
 - Weather and site conditions and temperatures;
 - Relevant calibration and QC data; and
 - Data for each sounding or profile should be recorded on a single sheet, if possible.
8. Survey Data - Survey data should include, in a tabular format, the following information:
 - Station # and/or survey line, per the survey plan;
 - Sampling interval if sampling continuously;
 - Coil spacing and configuration (unless specified in the heading);
 - Meter reading, in millimhos per meter (mmho/m) (conductivity) or parts per thousand (ppt) for in-phase; and
 - Notes of features (cars, powerlines, fences, trash, etc.) that may affect the data.

Special precautions to systematize and preserve data will be required for data that are recorded continuously on strip charges, magnetic tape, or in the memory of a recording device (such as an Omnidata Polycorder). Identifying header information must be recorded directly on the chart, tape, or file. Strip charts should be permanently affixed to the field log book. Magnetic tapes or memory devices should be downloaded at least daily and a hard copy obtained. The original hard copy of output should be similarly secured/stored.

2.0 CONCRETE CHIP SAMPLE COLLECTION

Scope and Application

Concrete chip sample collection provides information on monitoring surficial contamination.

Summary of Method

A chisel and hammer or electric hammer are used to obtain a chip sample of porous material (e.g., cement, brick) from flat surfaces such as floors.

Equipment

- Decontaminated beryllium chisel and hammer or electric hammer
- Engineers rule or pre-measured template
- Bristle brush
- Decontaminated or dedicated plastic dust pan
- Concrete patching material

Procedure

1. Using a decontaminated chisel and hammer or electric hammer, chip an area approximately 25 cm by 25 cm (or 625 square cm) to a depth of 1/8 to 1/4 inch.

2. Once the area has been chipped loose, use the natural bristle brush to sweep the sample onto the dust pan.
3. Transfer the chip sample from the dust pan into the sample jar using the bristle brush.
4. Using the engineers rule, record the final depth of the sample obtained.
5. Dispose or decontaminate sampling equipment.
6. Patch the void with concrete patching material.
7. Make a sketch in the field log book of sample location.

Precautions

- Wear clean gloves when collecting each sample.

3.0 SURFACE WATER/SEDIMENT SAMPLE COLLECTION

Scope and Application

Surface water samples provide an indication of the amount of contaminant in the water, while sediment samples indicate the amount of contamination adsorbed on sediment particles and/or the amount of wastes transported from the site. Two methods of collecting surface waters and two methods of collected sediments are presented as follows:

1. Surface Water - Direct Collection: Applicable for collection of surface waters from streams or small impoundments where access to the waters edge is possible or from a boat. This method is preferred when possible.
2. Surface Water - Bucket Method: Applicable for collecting water samples from bodies of water which are not easily accessible or when a sample is desired from the center of a lagoon.

3. Sediment - Core Tube Method: Generally applicable for collection of undisturbed sediment samples which may be needed for sectioning or in-situ analysis.
4. Sediment - Dredge Sample Method: Generally applicable for collection of disturbed sediment samples.

Whenever sediment samples are to be collected at a non-residential site, the type of sampling device to be used will be specified and justified in the site-specific work plan.

Surface Waters - Direct Collection

Summary of Method

In shallow surface waters, samples are collected by immersing the sample bottle directly into the water. The samples are collected starting at the downstream location and moving upstream.

Equipment

- Waders for shallow waters or a boat for deeper waters
- Disposable surgeons gloves

Procedure

Collect the surface water directly into the sample bottles as follows:

1. Remove the cap from the sample bottle(s).
2. Rinse the sample bottle with surface water and empty it downstream of the sampling location.
3. Holding the bottle with the opening pointed upstream, immerse the top of the bottle several inches under the water and allow it to fill.

4. Remove the bottle from the water and cap. Add the proper preservative prior to shipping the sample to the laboratory.

Precautions

If both surface water and sediment samples are collected at the same location, obtain the surface water sample first. Sediment sampling usually results in disturbance of the sediments which may influence the analytical results of the surface water samples.

- Collect VOA samples first.
- pH, conductivity, and temperature may be required. These measurements are taken directly on the water body after the sample is collected.
- Wear clean gloves when collecting each sample.

Sediment - Core Tubes

Summary of Method

If an undisturbed sediment sample is needed, the sample will be collected with a polyethylene core tube.

Equipment

- Decontaminated/dedicated polyethylene or teflon scoop or trowel
- Commercial 24-inch polyethylene core tube (Wildco or equivalent)
- Commercial gravity-type, messenger-activated core sampler
- Waders for shallow waters or small boat for deeper waters
- Decontaminated glass mixing bowl

Procedure - Shallow Cores

1. Uncap the core tube on both ends
2. Push the polyethylene tube into the sediment as far as it will go, then cap the free end. Remove it from the sediment slowly so as to recover as much of the sediment in the tube as possible.
3. Allow the core tube to settle and then pour off the excess water.
4. Extrude the section from the core tube and make the appropriate measurements such as length, stratigraphy, OVM readings, etc.
5. Transfer the sediment into the mixing bowl and homogenize the sediment. If the sample is being analyzed for volatile organics, place the portion to be analyzed for volatiles directly in the sample jar without mixing.
6. Fill the sample jar with sediment, cap the jar, and affix a sample label to the jar.
7. Discard the excess sediment in the location from which it was obtained.

Procedure - Deep Cores

1. Lower the gravity core sampler into the sediment.
2. Activate the messenger to close the sampler.
3. Withdraw the tube and decant off the excess water.
4. Extrude the section from the core tube and make the appropriate measurements such as length, stratigraphy, OVM readings, etc.

5. Transfer the sediment into the mixing bowl and homogenize the sediment. If the sample is being analyzed for volatile organics, place the portion to be analyzed for volatiles directly in the sample jar without mixing.
6. Fill the sample jar with sediment, cap the jar, and affix a sample label to the jar.
7. Discard the excess sediment in the location from which it was obtained.

Precautions

- Sediments must be collected starting at the downstream location proceeding upstream.
- Wear clean gloves when collecting each sample.

Sediments - Ponar Dredge

Summary of Method

If a disturbed sediment sample is needed, the following Ponar dredge method will be used for sample collection.

Equipment

- Decontaminated/dedicated scoop or trowel
- Decontaminated bucket constructed of polycarbonate or polyethylene
- Small boat for deeper waters
- Polyethylene or polypropylene rope
- Decontaminated Ponar sampler

Procedure

1. Attach the decontaminated sampler to a length of rope, open the jaws, and slowly lower it to the bottom.

2. Allow the rope to go slack once the bottom is reached. Raising the dredge will activate the mechanism to close the jaws.
3. Raise the sample, decant off the excess water, place the sediment in a bucket and homogenize the sample. If the sample is being analyzed for volatile organics, place the portion to be analyzed for volatiles directly in the sample jar without mixing.
4. Fill the sample jar with sediment, cap the jar, and affix a sample label to the jar.

Precautions

- Sediments must be collected starting at the downstream location proceeding upstream.
- Wear clean gloves when collecting each sample.

**BAYER ETS PROCEDURES FOR TDA
AND TDI EXTRACTION AND ANALYSIS**

Soxhlet Extraction

Method SP-3-Isocyanates and Amines

1.0 SCOPE AND APPLICATION

- 1.1 This method is a procedure for extraction of nonvolatile and semivolatile isocyanates and amines from solids such as soils and foams. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent.

2.0 SUMMARY OF METHOD

- 2.1 The solid sample is mixed with anhydrous sodium sulfate, placed in an extraction thimble or between two plugs of glass wool, and extracted using methylene chloride in a Soxhlet extractor. The material, contained in the thimble, is treated with a derivatizing reagent for 1 hour. The soil is then extracted using methylene chloride. A portion of the extract is concentrated and analyzed directly by high performance liquid chromatography. The remainder of the extract is processed to isolate the amines and the resultant extract analyzed by high performance liquid chromatography.

3.0 INTERFERENCES

- 3.1 A procedural blank is performed for the compounds of interest prior to the use of this method. The level of interferences must be below the method detection limit before this method is performed on actual samples.
- 3.2 More extensive procedures than those outlined in this method may be necessary for reagent purification.

4.0 APPARATUS AND MATERIALS

4.1 Soxhlet Extraction Units system:

- 4.1.1 Hot plates
- 4.1.2 Condensers
- 4.1.3 Soxhlet extraction tubes, 50-mm
- 4.1.4 Extraction flasks, flat bottom, 500-mL

- 4.2 Glass or paper thimble or glass wool: For retention of the sample in the Soxhlet extraction device. It should drain freely and may require purification before use.
- 4.3 Boiling chips, Fisher, porous, 10-40 mesh
- 4.4 Kuderna-Danish (K-D) apparatus:
 - 4.4.1 Concentrator tube, 10-mL, graduated, Kontes K-570050-1025, or equivalent
 - 4.4.2 Evaporation flask, 500-mL, Kontes K-570001-500, or equivalent: Attach to the concentrator tube with a plastic clamp, Kontes 675300-0019, or equivalent.
 - 4.4.3 Snyder column, three-ball macro, Kontes K-503000-0121, or equivalent
 - 4.4.4 Snyder column, two-ball micro, Kontes K-569001-0219, or equivalent
- 4.5 Funnel, glass, filled with Na_2SO_4 and a glass wool plug
- 4.6 Drying oven: Capable of maintaining a temperature of 105°C
- 4.7 Desiccator
- 4.8 Weighing pan, aluminum, disposable

5.0 REAGENTS

- 5.1 Methylene chloride, Fisher HPLC grade, pesticide quality, or equivalent
- 5.2 1-(2-Pyridyl) piperazine, Aldrich, 99.5% or equivalent
- 5.3 Sodium sulfate, anhydrous, Fisher ACS granular
- 5.4 Hydrochloric acid, Fisher ACS Grade
- 5.5 Potassium hydroxide, ACS Grade
- 5.6 Sodium borate decahydrate
- 5.7 Fluram, 4-phenylspiro[furan-2(3H),1'-phthalan]-3,3'-dione, Roche Chemical

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

- 6.1 Adhere to those procedures specified in the referring analytical methods for collection, preservation, and handling.

7.0 PROCEDURE

- 7.1 Blend 10 g of the solid sample with an equal weight of anhydrous sodium sulfate and place in either a glass or paper extraction thimble. The extraction thimble must drain freely for the duration of the extraction period. The use of a glass wool plug above and below the sample is also acceptable.

- 7.1.1 Reduction of particle size by grinding is permitted. Discard sticks, leaves, or rocks.
- 7.2 Add 1 mL of the surrogate spike solution and 1 mL of the matrix spike solution, if required.
- 7.3 Place the thimble in the extraction tube.
- 7.4 Add to the extraction tube, sufficient reagent consisting of 130 micrograms/ mL of 1-(2- pyridyl) piperazine in methylene chloride to nearly overflow the extraction tube. (The actual concentration of 1-(2- pyridyl) piperazine should be approximately four times the amount needed to ensure that the capacity of the derivatizing solution is not exceeded.) Place 250 mL of methylene chloride in a 500-mL extraction flask containing a boiling chip. Attach the flask to the extractor.
- 7.5 After one hour adjust the heat to allow the extraction to cycle once or twice per hour over a 16 to 24 hour period.
- 7.6 Allow the extract to cool after the extraction is complete.
- 7.7 Measure the final volume of the extract.
- 7.8 Evaporation Step:
- 7.8.1 Assemble a Kuderna-Danish (K-D) apparatus by attaching a 10-mL concentrator tube to a 500-mL evaporation flask. Pour 100 mL of the extract into the K-D apparatus through a glass funnel containing sodium sulfate plugged with glass wool.
- 7.8.2 Add one boiling chip to the flask and attach a three-ball Snyder column. Place the K-D apparatus on a hot water bath (80-90°C) so that the concentrator tube is partially immersed in the hot water. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood. When the apparent volume of the liquid reaches 1 mL, remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 min.
- 7.8.3 Attach a two-ball micro Snyder column to the concentrator tube and concentrate the sample to a final volume of 2.0 mL. Transfer the extract to a 2-mL crimp cap vial.
- 7.8.4 Extracts must be stored at 4°C until analyzed.
- 7.9 Amine Recovery:
- 7.9.1 The remaining methylene chloride extract is re-extracted with 10 mL of dilute hydrochloric acid (3 mL of concentrated acid diluted to 1 L).
- 7.9.2 Repeat the extraction 2 additional times and combine the extracts
- 7.9.3 Adjust the pH to 8-9 using potassium hydroxide solution (4 g/100 mL).
- 7.9.4 Add 10 mL of a 2.5 g/L aqueous solution of sodium borate decahydrate as buffer.
- 7.9.5 Add 4 mL of Fluram solution (175 mg/100 mL acetone).

- 7.9.6 Analyze the resulting solution by HPLC/fluorescence detector.

8.0 DETERMINATION OF PERCENT MOISTURE

- 8.1 Immediately after weighing the sample for extraction, weigh 5-10 g of the sample into a tared weighing pan.
- 8.2 Place the weighing pan in an oven set at 105°C and dry overnight.
- 8.3 Allow the pan to cool in a desiccator and reweigh the sample.
- 8.4 Calculate the percent moisture according to the following equation:
- $$\% \text{ Moisture} = [(W_i - W_f)/W_i] \times 100$$
- Where, W_i = initial weight, and W_f = final weight.
- 8.5 If the final weight is greater than the initial weight, repeat sections 8.1 to 8.4. If the final weight is still greater than the initial weight, record the initial weight value for both weights.

9.0 QUALITY CONTROL

- 9.1 Comprehensive quality control procedures are specified for each target compound in the referring analytical method.
- 9.2 The analyst must demonstrate that the compounds of interest are being quantitatively recovered before applying this method to actual samples.
- 9.3 The results from the analytical procedure will be expressed as micrograms/Kg dry weight along with the % moisture.
- 9.4 One blank will be included in each sample batch to determine if contamination has occurred.
- 9.5 One matrix spike/matrix spike duplicate will be analyzed for every 20 samples or for every sample batch, if the batch is less than 20 samples.

10.0 REFERENCES

- 10.1 Method 3540, SW-846, Second Edition.
- 10.2 Method 3540, SW-846, Third Edition.
- 10.3 Method 3540A, SW-846, Third Edition, Update I.

Soxhlet Extraction

Method SP-3-Isocyanates

1.0 SCOPE AND APPLICATION

- 1.1 This method is a procedure for extraction of nonvolatile and semivolatile isocyanates from solids such as soils and foams. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent.

2.0 SUMMARY OF METHOD

- 2.1 The solid sample is mixed with anhydrous sodium sulfate, placed in an extraction thimble or between two plugs of glass wool, and extracted using methylene chloride in a Soxhlet extractor. The solvent receiver contains a derivatizing reagent which reacts immediately with the isocyanate to give a stable derivative. The extract is concentrated and analyzed directly by high performance liquid chromatography.

3.0 INTERFERENCES

- 3.1 A procedural blank is performed for the compounds of interest prior to the use of this method. The level of interferences must be below the method detection limit before this method is performed on actual samples.
- 3.2 More extensive procedures than those outlined in this method may be necessary for reagent purification.

4.0 APPARATUS AND MATERIALS

- 4.1 Soxhlet Extraction Units system:
- 4.1.1 Hot plates
 - 4.1.2 Condensers
 - 4.1.3 Soxhlet extraction tubes, 50-mm
 - 4.1.4 Extraction flasks, flat bottom, 500-mL
- 4.2 Glass or paper thimble or glass wool: For retention of the sample in the Soxhlet extraction device. It should drain freely and may require purification before use.

- 4.3 Boiling chips, Fisher, porous, 10-40 mesh
- 4.4 Kuderna-Danish (K-D) apparatus:
 - 4.4.1 Concentrator tube, 10-mL, graduated, Kontes K-570050-1025, or equivalent
 - 4.4.2 Evaporation flask, 500-mL, Kontes K-570001-500, or equivalent: Attach to the concentrator tube with a plastic clamp, Kontes 675300-0019, or equivalent.
 - 4.4.3 Snyder column, three-ball macro, Kontes K-503000-0121, or equivalent
 - 4.4.4 Snyder column, two-ball micro, Kontes K-569001-0219, or equivalent
- 4.5 Funnel, glass, filled with Na_2SO_4 and a glass wool plug
- 4.6 Drying oven: Capable of maintaining a temperature of 105°C
- 4.7 Desiccator
- 4.8 Weighing pan, aluminum, disposable

5.0 REAGENTS

- 5.1 Methylene chloride, Fisher HPLC grade, pesticide quality, or equivalent
- 5.2 1-(2-Pyridyl) piperazine, Aldrich, 99.5% or equivalent
- 5.3 Sodium sulfate, anhydrous, Fisher ACS granular

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

- 6.1 Adhere to those procedures specified in the referring analytical methods for collection, preservation, and handling.

7.0 PROCEDURE

- 7.1 Blend 10 g of the solid sample with an equal weight of anhydrous sodium sulfate and place in either a glass or paper extraction thimble. The extraction thimble must drain freely for the duration of the extraction period. The use of a glass wool plug above and below the sample is also acceptable.
 - 7.1.1 Reduction of particle size by grinding is permitted. Discard sticks, leaves, or rocks.
- 7.2 Add 1 mL of the surrogate spike solution and 1 mL of the matrix spike solution; if required.
- 7.3 Place 300 mL of the extraction solvent and 40 mg of 1-(2-pyridyl) piperazine into a 500-mL extraction flask containing a boiling chip. The actual concentration of 1-(2-pyridyl) piperazine should be approximately four times the amount needed to ensure that the

capacity of the derivatizing solution is not exceeded. Attach the flask to the extractor.

7.4 Place the thimble in the extraction tube.

7.5 Adjust the heat to allow the extraction to cycle once or twice per hour over a 16 to 24 hour period.

7.6 Allow the extract to cool after the extraction is complete.

7.7 Evaporation Step:

7.7.1 Assemble a Kuderna-Danish (K-D) apparatus by attaching a 10-mL concentrator tube to a 500-mL evaporation flask. Pour the extract into the K-D apparatus through a glass funnel containing sodium sulfate plugged with glass wool.

7.7.2 Add one boiling chip to the flask and attach a three-ball Snyder column. Place the K-D apparatus on a hot water bath (80-90°C) so that the concentrator tube is partially immersed in the hot water. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood. When the apparent volume of the liquid reaches 1 mL, remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 min.

7.7.3 Attach a two-ball micro Snyder column to the concentrator tube and concentrate the sample to a final volume of 2.0 mL. Transfer the extract to a 2-mL crimp cap vial.

7.7.4 Extracts must be stored at 4°C until analyzed.

8.0 DETERMINATION OF PERCENT MOISTURE

8.1 Immediately after weighing the sample for extraction, weigh 5-10 g of the sample into a tared weighing pan.

8.2 Place the weighing pan in an oven set at 105°C and dry overnight.

8.3 Allow the pan to cool in a desiccator and reweigh the sample.

8.4 Calculate the percent moisture according to the following equation:

$$\% \text{ Moisture} = [(W_i - W_f)/W_i] \times 100$$

Where, W_i = initial weight, and W_f = final weight.

8.5 If the final weight is greater than the initial weight, repeat sections 8.1 to 8.4. If the final weight is still greater than the initial weight, record the initial weight value for both weights.

9.0 QUALITY CONTROL

9.1 Comprehensive quality control procedures are specified for each target compound in the referring analytical method.

9.2 The analyst must demonstrate that the compounds of interest are being quantitatively recovered before applying this method to actual samples.

- 9.3 The results from the analytical procedure will be expressed as micrograms/Kg dry weight along with the % moisture.
- 9.4 One blank will be included in each sample batch to determine if contamination has occurred.
- 9.5 One matrix spike/matrix spike duplicate will be analyzed for every 20 samples or for every sample batch, if the batch is less than 20 samples.

10.0 REFERENCES

- 10.1 Method 3540, SW-846, Second Edition.
- 10.2 Method 3540, SW-846, Third Edition.
- 10.3 Method 3540A, SW-846, Third Edition, Update I.

Analysis of Toluene Diamine by High Performance Liquid Chromatography (HPLC)

1.0 SCOPE AND APPLICATION

1.1 This method covers the determination of derivatized toluene diamine prepared by Method SP-3-Isocyanates/Amines.

<u>Compound Name</u>	<u>CAS No.</u>
2,4-Toluene Diamine	95-80-7
2,6-Toluene Diamine	832-40-5

1.2 This method is restricted to use by, or under the supervision of, analysts experienced in the use of chromatography and in the interpretation of chromatograms. Each analyst must demonstrate the ability to generate acceptable results with this method.

1.3 The toxicity of each reagent has been precisely defined. The exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding safe handling of the chemicals specified in this method. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Refer to the Chemical Hygiene Plan for additional information regarding laboratory safety.

2.0 SUMMARY OF THE METHOD

2.1 Samples obtained by Method SA-3-Isocyanates/Amines are analyzed by HPLC utilizing a fluorescence detector.

3.0 INTERFERENCES

3.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. All of these materials must be routinely demonstrated to be free from interferences under conditions of the analysis by preparing and analyzing laboratory method (or reagent) blanks.

3.1.1 Glassware must be cleaned thoroughly before using. The glassware is washed with laboratory detergent in hot water followed by rinsing with tap water and distilled water.

3.1.2 The use of high purity reagents and solvents helps to minimize interference problems in sample analysis.

4.0 APPARATUS AND MATERIALS

- 4.1 HPLC with at least a binary pumping system capable of a programmed gradient
- 4.2 Column - ODS Hypersil, 0.46 x 25 cm (or equivalent)
- 4.3 Guard Column - Alltech Hypersil ODS C18, 10 mm x 4.6 mm ID, 5 micron particle size (or equivalent)
- 4.4 Fluorescence Detector: Excitation at 390 nm; Emission at 484 nm
- 4.5 Data system for measuring peak areas and retention times

5.0 REAGENTS

- 5.1 Acetonitrile, CH₃CN (ACN) - HPLC Grade or equivalent
- 5.2 Water, H₂O - HPLC Grade or equivalent
- 5.3 Triethylamine

6.0 SAMPLE HANDLING

- 6.1 The samples from Method SP-3-Isocyanates/Amines must be analyzed immediately.

7.0 PROCEDURE

7.1 Chromatographic Analysis

Chromatographic Conditions

Column:	ODS Hypersil, 0.46 x 25 cm
Mobile Phase	A: 90:10 Water/Acetonitrile with 0.5 mL triethylamine/liter B: Acetonitrile
Gradient:	Isocratic 88% A and 12% B for 12 minutes, purge at 50% A and 50 % B for 12 minutes, then equilibrate at 88% A and 12% B for 15 minutes
Flow Rate	1 mL/minute
Fluorescence	Excitation: 390; Emission: 484, 450 nm cutoff
Detector	filter
Injection	200 microliters
Volume	

7.2 Calibration

- 7.2.1 Establish the retention times for each TDA isomer using the chromatographic conditions provided above. Prepare derivatized calibration standards. Calibrate the chromatographic system using the external standard technique (Section 7.2.3).

7.2.2. Preparation of calibration standards. Calibrate the instrument from 1 to 20 micrograms/mL.

7.2.3. External standard calibration procedure. Analyze each derivatized calibration standard using the chromatographic conditions and tabulate peak area against concentration injected.

The working calibration curve must be verified on each working day by the measurement of one or more calibration standards. If the response for any analyte varies from the target response by more than 10%, the test must be repeated using fresh calibration standard after it is verified that the analytical system is in control. Alternatively, a new calibration curve may be prepared for that compound.

7.3 Analysis

7.3.1 Analyze samples by HPLC, using conditions established in Section 7.1.1.

7.3.2 The width of the retention time window used to make identifications will be based upon measurements of actual retention time variations of standards over the course of a day.

Three times the standard deviation of a retention time for a compound can be used to calculate a suggested window size; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms.

7.3.3 If the peak area exceeds the linear range of the calibration curve, the sample must be diluted and reanalyzed.

7.4 Calculations

7.4.1 Calculate the correlation coefficient, slope and intercept for the calibration data using the least squares method for linear regression. Concentrations are expressed as the x-variable and response is expressed as the y-variable.

7.4.2 Calculate the concentration of TDA isomers in the sample:
$$\text{Concentration (micrograms/mL)} = [\text{Sample Response (area)} - \text{Intercept}] / \text{Slope}$$

7.4.3 Calculate the total amount collected in the sample by multiplying the concentration (micrograms/mL) times the final volume.

$$\text{Amount TDA (micrograms)} = \text{Concentration (micrograms/mL)} \times \text{Final Volume}$$

7.4.4 Calculate the Total Amount of TDA in Initial Extract by dividing the Amount of TDA by the Volume of methylene chloride extracted and multiply that result by 100 mL (Amount used for TDI) plus the volume extracted.

Total TDA (micrograms) = (Amount of TDA/Volume of methylene chloride) x (100 mL + Volume of methylene chloride extracted)

- 7.4.5 Calculate the concentration in the sample matrix by dividing the amount of TDA (micrograms) by the dry weight of the sample as determined in SP-3-Isocyanates.

Concentration (ppm) = Amount Isocyanate (micrograms)/Sample weight (dry, grams)

8.0 QUALITY CONTROL

- 8.1 The correlation coefficient for the calibration curve must be 0.995 or greater. If the correlation coefficient is less than 0.995, the HPLC system will be examined for problems, and a fresh calibration curve will be prepared and analyzed.
- 8.2 A solvent blank will be analyzed daily to verify that the system is not contaminated.
- 8.3 A calibration standard will be analyzed prior to any samples being analyzed, after every 10 injections and at the end of the sample set. Samples must be bracketed by calibration standards that have a response that does not vary by more than 10% of the target value. If the calibration standards are outside the limit, the samples must be reanalyzed after it is verified that the analytical system is in control.
- 8.4 A method blank will be prepared and analyzed for every 10 samples concentrated.
- 8.5 A method spike will be prepared and analyzed for every 20 samples. The response for each analyte will be within 20% of the target response.

9.0 METHOD PERFORMANCE

- 9.1 Detection limit concentrations are obtained by determining the standard deviation of the area count for seven replicate injections and then multiplying the standard deviation for seven replicate injections by the student's t-value at the 95% confidence level (3.143).

Analysis of Isocyanates by High Performance Liquid Chromatography (HPLC)

1.0 SCOPE AND APPLICATION

1.1 This method covers the determination of derivatized isocyanates prepared by Method SP-3-Isocyanates.

<u>Compound Name</u>	<u>CAS No.</u>
2,4-Toluene Diisocyanate	584-84-9
2,6-Toluene Diisocyanate	91-08-7
1,6-Hexamethylene Diisocyanate	822-06-0
Methylene Diphenyl Diisocyanate	101-68-8

1.2 This method is restricted to use by, or under the supervision of, analysts experienced in the use of chromatography and in the interpretation of chromatograms. Each analyst must demonstrate the ability to generate acceptable results with this method.

1.3 The toxicity of each reagent has been precisely defined. The exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding safe handling of the chemicals specified in this method. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Refer to the Chemical Hygiene Plan for additional information regarding laboratory safety.

2.0 SUMMARY OF THE METHOD

2.1 Samples obtained by Method SA-3-Isocyanates are evaporated to dryness under a stream of nitrogen, brought to volume with acetonitrile and analyzed by HPLC.

3.0 INTERFERENCES

3.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. All of these materials must be routinely demonstrated to be free from interferences under conditions of the analysis by preparing and analyzing laboratory method (or reagent) blanks.

3.1.1 Glassware must be cleaned thoroughly before using. The glassware is washed with laboratory detergent in hot water followed by rinsing with tap water and distilled water.

- 3.1.2 The use of high purity reagents and solvents helps to minimize interference problems in sample analysis.

4.0 APPARATUS AND MATERIALS

- 4.1 Separatory Funnel - 500 mL or larger, with Teflon® Stopcock
- 4.2 Glass Funnel - Short stemmed or equivalent
- 4.3 Vials - 15 mL capacity with Teflon® lined caps
- 4.4 Class A Volumetric Flask - 5 mL for bringing sample to volume after concentration
- 4.5 Filter Paper - Scientific Products Grade 370 Qualitative or equivalent
- 4.6 Buchner Funnel - Porcelain with 100 mm ID or equivalent
- 4.7 Erlenmyer Flask - 500 mL with side arm and vacuum source
- 4.8 HPLC with at least a binary pumping system capable of a programmed gradient
- 4.9 Column - Alltech Altima C18, 250 mm x 4.6 mm ID, 5 micron particle size (or equivalent)
- 4.10 Guard Column - Alltech Hypersil ODS C18, 10 mm x 4.6 mm ID, 5 micron particle size (or equivalent)
- 4.11 Diode Array Detector at 254 nm
- 4.12 Fluorescence Detector: Excitation at 240 nm; Emission at 370 nm
- 4.13 Data system for measuring peak areas and retention times

5.0 REAGENTS

- 5.1 Acetonitrile, CH_3CN (ACN) - HPLC Grade or equivalent
- 5.2 Methylene Chloride, CH_2Cl_2 - HPLC Grade or equivalent
- 5.3 Hexane, C_6H_{14} - Pesticide Grade or equivalent
- 5.4 Water, H_2O - HPLC Grade or equivalent
- 5.5 Ammonium Acetate, $\text{CH}_3\text{CO}_2\text{NH}_4$
- 5.6 Acetic Acid (glacial), $\text{CH}_3\text{CO}_2\text{H}$
- 5.7 1-(2-Pyridyl) piperazine, Aldrich, 99.5+% or equivalent
- 5.8 Derivatization Solution: Prepare a solution of 1-(2-pyridyl) piperazine in methylene chloride at a concentration of 40 mg/300 mL. This solution is used for method blanks and method spikes.
- 5.9 Ammonium Acetate Buffer Solution (AAB): Prepare a solution of ammonium acetate in water at a concentration of 0.1 M by transferring 7.705 g of ammonium acetate to a 1000 mL volumetric flask and diluting to volume with HPLC Grade water. Adjust pH to 6.2 with glacial acetic acid.

6.0 SAMPLE HANDLING

6.1 The samples from Method SP-3-Isocyanates must be stored at 4°C between the time of extraction and concentration. Each sample will be concentrated within 30 days of extraction.

7.0 PROCEDURE

7.1 Preparation of isocyanate derivatives

7.1.1 HDI, TDI, MDI

7.1.1.1 Dissolve 500 mg of each isocyanate in individual 100 mL aliquots of methylene chloride, except for MDI which requires 250 mL of methylene chloride. Transfer a 5 mL aliquot of 1-(2-pyridyl) piperazine to each of the solutions, stir and allow to sit overnight at room temperature. Transfer 150 mL aliquots of hexane to each of the solutions to precipitate the isocyanate-urea. Using a Buchner funnel, vacuum filter the solid-urea and wash with 50 mL of hexane. Dissolve the precipitate in a minimum aliquot of methylene chloride. Repeat the hexane precipitation and filtration twice. After the third filtration, dry the crystals at 50°C and transfer to amber bottles for storage. The crystals are stable for 5+ years when stored at room temperature in a closed container.

Molecular Weight of the Free Isocyanates and the Isocyanate-Urea

<u>Analyte</u>	<u>MW (Free Isocyanate)</u>	<u>MW (Derivative)</u>
1,6-HDI	168	494.44
2,4-TDI	174.16	500.56
2,6-TDI	174.16	500.56
MDI	250.25	576.65

7.2 Concentration of Samples

7.2.1 Transfer an aliquot (1 mL) of each sample (Method SP-3-Isocyanates) to a 5 mL volumetric flask. Evaporate gently to dryness using an oil-free stream of nitrogen gas. Dilute the sample to volume with ACN. After thorough mixing, transfer an aliquot to a 2 mL autosampler vial and seal with a Teflon® crimp cap. Store the vial at 4°C until analysis.

7.3 Chromatographic Analysis

Chromatographic Conditions

Column:	C18, 250 mm x 4.6 mm ID, 5 micron particle size
Mobile Phase	Acetonitrile/Ammonium Acetate Buffer
Gradient:	10:90 (V/V) ACN:AAB to 60:40 (V/V) ACN:AAB over 30 minutes
Flow Rate	2 mL/minute
Diode Array	254 nm
Detector	
Fluorescence	Excitation: 240; Emission: 370
Detector	
Injection	50 microliters
Volume	

Retention Times of the Isocyanates

<u>Compound</u>	<u>Retention Time</u>	<u>Detection Limit</u> <u>(microgram/mL)*</u>
1,6-HDI	19.9	0.132
2,4-TDI	27.1	0.036
MDI	27.3	0.036

*The detection limit is for the instrument conditions given above at the 95% confidence level for seven replicate injections for the UV detector only.

7.5.2 Calibration

7.5.2.1 Establish the retention times for each of the isocyanates of interest using the chromatographic conditions provided above. The retention times provided in the above table are provided only as a guide to relative retention times. Prepare derivatized calibration standards (concentrations expressed in terms of the free isocyanate, Section 7.5.4.1) according to the procedure in Section 7.5.2.1.1. Calibrate the chromatographic system using the external standard technique (Section 7.5.2.1.2).

7.5.2.1.1 Preparation of calibration standards. Prepare a 100 microgram/mL stock solution of the isocyanates of interest from the urea. Calibrate the instrument from 1 to 20 micrograms/mL.

7.5.2.1.2 External standard calibration procedure. Analyze each derivatized calibration standard using the chromatographic conditions listed in Section 7.5.1 and tabulate peak area against concentration injected.

The working calibration curve must be verified on each working day by the measurement of one or more calibration standards. If the response for any analyte varies from the target response by more than 10%, the test must be repeated using fresh calibration standard after it is verified that the analytical system is in control.

Alternatively, a new calibration curve may be prepared for that compound.

7.5.3 Analysis

7.5.3.1 Analyze samples by HPLC, using conditions established in Section 7.5.2.1.

7.5.3.2 The width of the retention time window used to make identifications will be based upon measurements of actual retention time variations of standards over the course of a day.

Three times the standard deviation of a retention time for a compound can be used to calculate a suggested window size; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms.

7.5.3.3 If the peak area exceeds the linear range of the calibration curve, the sample must be diluted with ACN and reanalyzed.

7.5.4 Calculations

7.5.4.1 Conversion from isocyanate to urea. The equation for converting the amount of free isocyanate to the corresponding amount of isocyanate-urea is as follows:

Amount of Urea = Amount of Free Isocyanate X (MW of the Isocyanate-Urea/MW of the Isocyanate)

The equation for converting the amount of isocyanate-urea to the corresponding amount of free isocyanate is as follows:

Amount of Isocyanate = Amount of Isocyanate Urea X (MW of the Isocyanate /MW of the Isocyanate-Urea)

7.5.4.2 Calculate the correlation coefficient, slope and intercept for the calibration data using the least squares method for linear regression. Concentrations are expressed as the x-variable and response is expressed as the y-variable.

7.5.4.3 Calculate the concentration of isocyanate in the sample:

Concentration (micrograms/mL) = [Sample Response(area) - Intercept]/Slope

7.5.4.4 Calculate the total amount collected in the sample by multiplying the concentration (micrograms/mL) times the final volume of ACN (5 mL).

Amount Isocyanate (micrograms) = Concentration (micrograms/mL) X Final Volume (5 mL)

7.5.4.5 Calculate the concentration in the sample matrix by dividing the amount of isocyanate (micrograms) by the dry weight of the sample as determined in SP-3-Isocyanates.

Concentration (ppm) = Amount Isocyanate (micrograms)/Sample weight (dry, grams)

8.0 QUALITY CONTROL

- 8.1 The correlation coefficient for the calibration curve must be 0.995 or greater. If the correlation coefficient is less than 0.995, the HPLC system will be examined for problems, and a fresh calibration curve will be prepared and analyzed.
- 8.2 A solvent blank will be analyzed daily to verify that the system is not contaminated.
- 8.3 A calibration standard will be analyzed prior to any samples being analyzed, after every 10 injections and at the end of the sample set. Samples must be bracketed by calibration standards that have a response that does not vary by more than 10% of the target value. If the calibration standards are outside the limit, the samples must be reanalyzed after it is verified that the analytical system is in control.
- 8.4 A method blank will be prepared and analyzed for every 10 samples concentrated (Section 7.4).
- 8.5 A method spike will be prepared and analyzed for every 20 samples. The response for each analyte will be within 20% of the target response (Section 7.3).

9.0 METHOD PERFORMANCE

- 9.1 Detection limit concentrations are obtained by determining the standard deviation of the area count for seven replicate injections and then multiplying the standard deviation for seven replicate injections by the student's t-value at the 95% confidence level (3.143).
- 9.2 This method has been tested for linearity over the range from 2 to 500 times the estimated instrument detection limit (IDL) for each isocyanate. The estimated IDLs for HDI, TDI, and MDI are 1.98, 0.53, and 0.56 ng on column (UV Detection) respectively. These values may vary from instrument to instrument.

BAYER ETS SCREENING METHOD FOR TDI

Screening Method for Toluene Diisocyanate (TDI)

Method SC-1

Spot Test Utilizing Reagent Impregnated Tape

1.0 Scope and Application

1.1 Method SC-1 is used to determine the presence of free toluene diisocyanate in a variety of matrices such as soil, residues, and liquids. Toluene diisocyanate can be detected at approximately 5 parts per billion in non-aqueous liquids and at 1 part per million in soils.

2.0 Summary of Method

- 2.1 A sample of solid material is shaken with a solvent and several drops of the extractant is placed on an diisocyanate indicating paper. If an isocyanate is present, the paper changes from a light yellow color to a pink color.
- 2.2 In the case of liquids and semi-solids, the paper is dipped in the material and color formation is monitored.

3.0 Interferences

- 3.1 The reagent paper is not specific to toluene diisocyanate and other diisocyanates will give a positive test.
- 3.2 Toluene diisocyanate reacts readily with water, alcohols, and amines. The half-life of 10 ppm toluene diisocyanate in water has been determined to be less than 30 minutes.

4.0 Safety

- 4.1 Refer to appropriate material safety data sheets (MSDSs) for all of the chemicals, reagents, and standards used in this method. MSDSs are available from the supplier of the reagent or chemical upon request. Keep all MSDS sheets available for reference purposes.
- 4.2 Toluene diisocyanate is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200.
- 4.3 Unknown samples should be opened in a hood and handled with gloves to prevent exposure.
- 4.4 This method does not address all the safety issues associated with its use. Refer to the appropriate OSHA regulations regarding the safe handling of chemicals.

5.0 Equipment and Supplies

- 5.1 Analytical Balance. Capable of weighing to the nearest 1.0 mg.
- 5.2 Volumetric flasks, Class A, 100 mL.
- 5.3 Syringes, various volumes.
- 5.4 Glass bottles, 4 ounce with screw caps.

6.0 Reagents and Standards

- 6.1 Toluene, water free.
- 6.2 98% Toluene, 2,4-diisocyanate (2,4-Toluene diisocyanate) Aldrich, T3,985-3.
- 6.3 Diisocyanate paper tape for continuous monitoring systems: Diisocyanates, Part Number 700506 (MDA Scientific, Inc., 405 Barclay Boulevard, Lincolnshire, IL 60069)

7.0 Sample Collection, Preservation, Shipment, and Storage

- 7.1 Samples should be collected in glass bottles that have been thoroughly cleaned and rinsed to remove soluble contaminants and dry. Amber bottles should be used whenever possible to avoid ultraviolet light.

8.0 Quality Control

- 8.1 All quality control data should be available for easy reference or inspection.
- 8.2 A minimum of one blank per sample batch should be processed to determine if contamination or any memory effects are occurring.
- 8.3 A minimum of one matrix spike per sample batch should be processed to demonstrate that toluene diisocyanate could be detected in present.

9.0 Procedure

- 9.1 Place 25 g of each sample to be tested in separate glass bottles.
- 9.2 Add 5 mL of dry toluene to each sample.
- 9.3 Shake the suspension for 1 minute.
- 9.4 Transfer an aliquot of the toluene extract to the indicating paper by touching a small piece of the diisocyanate indicating paper and allow the toluene solvent to flow on by capillary action.

- 9.5 As the toluene evaporates, a faint pink color will develop if toluene diisocyanate is present.

10.0 Method Performance

- 10.1 Since Toluene diisocyanate reacts readily with a number of chemical classes and with water, the method was validated using sea san spiked at 0.9 ppm toluene diisocyanate.

11.0 Pollution Prevention

- 11.1 The reagents used in this method pose little threat to the environment when managed properly.
- 11.2 All reagents and standards should be prepared in volumes consistent with laboratory use to minimize the generation of waste.

12.0 Waste Management

- 12.1 The laboratory should follow all federal, state, and local regulations governing waste management. See the site coordinator for waste management (or appropriate person or documentation) at each site for specific requirements.

APPENDIX B-2

QAPP RESPONSE TO COMMENTS

**BAYER - NEW MARTINSVILLE
RESPONSE TO QAPP COMMENTS**

**QAPP DATED FEBRUARY 27, 1995
EPA LETTER DATED AUGUST 7, 1995**

General

Comment 1: The QAPP is a generic because it contains no site-specific sampling and analysis information. The stated intent is to document specifics in the work plan. Since the QAPP is a document of record and is generally the standard by which data collection activities are audited, it is suggested that Bayer prepare a site-specific sampling and analysis plan (SAP). To avoid duplication, sections of the SAP could reference relevant text in the generic plan.

Response: A site-specific field sampling and analysis plan is included in Section 3 of this RFI Work Plan.

Section 4 - Quality Assurance Objectives, Page 6

Comment 2: The guidance referred to on this page and throughout the document is outdated. The new guidance is "Guidance for Planning for Data Collection in Support of Environmental Decision Making. Using the Data Quality Objectives Process," EPA/QA/G-4 (1994) (copy enclosed). This document categorizes data types as either definitive or screening. The levels referred to in the QAPP no longer exist. the language throughout the QAPP should reflect the new guidelines.

Response: Section 4 of the QAPP has been revised to incorporate EPA's document "Guidance for the Data Quality Objectives Process", EPA/QA/G-4 (September, 1994). Revisions have been made to both text and tables in Section 4. The revised QAPP pages are included in Appendix B-3 of this document.

Page 6, Paragraph 3

Comment 3: The analytical level stated for groundwater analysis is inconsistent with the information in Table 4-1.

Response: Table 4-2 was revised to indicate an Analytical Level of III for both groundwater and soil samples analyzed for VOCs, etc.

Table 4-3

Comment 4: The "analytical level" heading should be changed to Data Type.

Response: The analytical levels on this table are still considered to be informative and therefore remain as a heading on Table 4-3. Table 4-3 has been modified, however, to include a new column with the heading "Data Type"

Subsection 4.4 - Representativeness

Comment 5: All of the precision, accuracy, representativeness, comparability, completeness (PARCC) parameters are relative to both field and laboratory. The discussion on representativeness does not reflect the analytical component.

Response: The second paragraph of Section 4.4 has been revised as follows:

Sampling protocols (discussed in Section 5 of this document) have been developed to assure that samples collected are representative of the media. In addition, the laboratory has established sample preparation protocols (included in Appendix A of this document) to assure that aliquots of the sample used for analysis are representative of the sample as submitted from the field. Field and laboratory handling protocols (e.g. storage, handling in the field, and shipping) have also been designed to protect the representativeness of the collected samples. Proper field documentation will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

Subsection 4.6 - Completeness

Comment 6: Completeness goals should be based on the amount of data that allows project managers to make decision with the necessary degree of confidence to support project objectives. This requires that critical data points have been identified in the planning phase. Without this input, completeness goals are estimates. And while they may be achievable, they are not accurate. The goal of 90% does not include this element.

Response: The goal of 90% completeness is a general goal incorporating all data. Critical data points have been initially identified as the sample locations in Section 3 of the RFI Work Plan. However, in the same manner that the amount of data lost due to sampling and analytical error cannot be predetermined, all critical data points cannot be determined in advance. In some instances, data points determined as critical in the planning phase may not be critical after review of the analytical results; or data points determined not to be critical in the planning phase may be critical after review of the analytical results. Therefore, the sampling scheme presented in the RFI Work Plan has been designed to minimize the effect of one lost data point as much as possible. Also, as stated in the last sentence of Section 4.6, "critical locations or parameters for which data are determined to be inadequate may be resampled." Based on the preceding discussion, revisions to the completeness section in the QAPP are not warranted.

Section 5 - Sampling Procedures

Comment 7: Sampling procedures should include a step for preserving samples (e.g., on ice, 4°C). This step is not included in all of the applicable procedures.

Response: Sample preservation information was added to those procedures in Section 5 from which it is absent. Specifically, Step 5 of the procedure for Surface Soil Sample Collection (Section 5.1) was revised to the following:

Cap and tighten the sample container and affix a label to the container. The samples will be placed on ice and cooled to 4°C immediately after they are collected. Place sufficient ice with the samples to ensure they are cooled to and will maintain a maximum temperature of 4°C prior to shipment off-site or delivery to Bayer ETS.

Step 7 was added to the procedure for Subsurface Soil Sample Collection (Section 5.2) using a split-barrel sampler as follows:

7. Cap and tighten the sample container and affix a label to the container. The samples will be placed on ice and cooled to 4°C immediately after they are collected. Place sufficient ice with the samples to ensure they are cooled to and will maintain a maximum temperature of 4°C prior to shipment off-site or delivery to Bayer ETS.

Step 7 of the procedure for Groundwater Sample Collection (Section 5.3) was modified to include the following:

Cap and tighten the sample container and affix a label to the container. The samples will be placed on ice and cooled to 4°C immediately after they are collected. Place sufficient ice with the samples to ensure they are cooled to and will maintain a maximum temperature of 4°C prior to shipment off-site or delivery to Bayer ETS.

Section 5.9 - Soil Gas Survey

Comment 8: The calibration frequency is listed as every 10 samples or daily. Calibration requirements should be specifically stated (e.g., every ten samples or daily, whichever is more frequent).

Response: The first sentence of Step 10 of this procedure was revised as follows:

The calibration will be verified every 10 samples or daily, whichever is more frequent.

Section 5.10 - Field Filtration

Comment 9: The filter size proposed is inconsistent with Regional guidance. Exceptions should be approved by the EPA Project Manager.

Response: Section 5.10 was revised to reflect the use of a 0.45 µm filter, consistent with regional guidance.

Section 5.15.1 - Sample Numbering System

Comment 10: Field Q.C. samples such as field blanks and trip blanks are spelled out on the sampling level. These samples should be blind to the laboratory.

Response: Bayer disagrees with the delivery of field QC samples to the laboratory as blind. Because the laboratory is compelled to follow set protocols when storing, preparing, and analyzing samples; and they are forced to treat all samples, whether they are samples, blanks, or other QA/QC samples, in the same manner, there is no reason to submit field QC samples blind. The benefit of identifying field and trip blanks is to avoid confusion if it becomes necessary for the laboratory to choose an alternate sample for performing an MS/MSD or duplicate analysis, because it is invalid to use trip or field blanks for this purpose. As a result, no revisions to this section of the QAPP are necessary.

Section 8 - Analytical Procedures

Comment 11: Table 8-1 lists a number of method detection limits as variable. The QAPP must state the detection limits required to address project needs (e.g., risk assessment, ARARs) and the selected analytical methods which will achieve those limits.

Response: The analytical methods for which the method detection limits are listed as variable in Table 8-1 are used to analyze a multitude of parameters. The footnotes on these entries direct the reader to method descriptions either in Appendix B-1 or EPA SW-846, where the method detection limits for each parameter are identified. However, for the analysis of mercury in a water matrix, the method detection limit was revised to 0.2 µg/l as stated in EPA SW-846 method 7470. No other revisions to this section are necessary.

Section 9.2 - Data Validation

Comment 12: This section notes that selected data will be validated. If this scenario is approved by EPA, it should be clear that it is the EPA project manager who makes the decision rather than facility personnel.

For clarification purposes, please note that data validation is not simply a check of laboratory compliance as inferred by this section. But more appropriately, data validation is an invaluable tool for assessing data usability (e.g., can data be used for the intended purpose?).

Response: The second sentence of the second paragraph of Section 9.2 was revised as follows:

Key decision making data points, as selected by the Bayer project manager with approval of the EPA project manager, will be validated.

Also, the following sentences were added to the same paragraph prior to the last sentence which begins "All validation will be...":

After the determination of data quality, a determination will be made by the validator as to the usability of the data for its intended purpose. If the data is determined not to be usable, a decision will be made whether to resample, reanalyze, or continue the investigation without this data.

Laboratory QAPP - General

Comment 13: The laboratory contains analytical method SOPs based on EPA methods. The EPA method for each SOP should be referenced.

Response: The final section of each laboratory procedure references all methods used to develop the laboratory procedure. No revisions to the QAPP are necessary to address this comment.

Laboratory QAPP - SA-45-6

Comment 14: This procedure requires subtraction of reagent blank concentration from sample results. This is not consistent with regional protocol. Sample concentrations should be reported without blank corrections.

Response: Section 9.1, which requires the subtraction of the reagent blank results was removed from the procedure.

Comment 15: The facility must amend the QAPP to overcome the deficiencies noted in the review, and submit a site-specific SAP as a companion to the generic QAPP.

Response: The QAPP will be amended and redistributed upon EPA approval of the responses to QAPP comments contained herein. The specific revisions to QAPP pages affected by the revision are included as Appendix B-3. Specific revisions to the text are highlighted where additional text was needed. No highlighting is provided where text was removed to address the comment.

APPENDIX B-3

QAPP REVISIONS

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4.0 QUALITY ASSURANCE OBJECTIVES

4.1 DATA QUALITY OBJECTIVES

The USEPA developed the Data Quality Objective (DQO) process as a tool to be employed during project planning. Use of the DQO process will help to clarify the study objectives, define the appropriate quantity and quality of data to be collected, determine the conditions under which to collect the data, and specify acceptable error levels which will allow the data to support the final decisions to be made at the site. This section gives a brief overview of the DQO process, and then describes how the process was used in planning Bayer New Martinsville RFI. It should be emphasized that the DQO process does not produce a separate deliverable; it is a tool that is used to aid and facilitate the project planning process.

4.1.1 DQO Process

The DQO process is a series of seven steps that are designed to ensure that the type, quantity, and quality of environmental data used in the decision making are appropriate for the intended application. The process described in this section is detailed in "Guidance for the Data Quality Objective Process", EPA QA/G-4, September, 1994. Each step in the process produces an output which is used as input to succeeding steps. The seven steps are described below.

- **Step 1 - State the Problem.** Clearly and concisely define the reason for the investigation, thus focusing the objectives. The results of previous studies (if any), can be used to help formulate the present problem at the site.
- **Step 2 - Identify the Decision.** Reformulate the problem into a measurable question. The decision statement is a pronouncement of what question must be resolved or answered to address the problem identified in Step 1, and is basically putting the problem into a measurable form.
- **Step 3 - Identify Inputs.** Determine what additional information is needed to resolve the decision, including existing data that must be reviewed as well as new data that must be collected.
- **Step 4 - Define the Boundaries of the Study.** Clearly identify the boundaries of the site both spatially (the area to be studied) and temporally (when to collect data and over what time frame the study applies).
- **Step 5 - Develop a Decision Rule.** Consolidate the decision statement, inputs, and boundary conditions into a single "if...then" statement that identifies the parameter(s) of interest, the action level(s), and the alternatives associated with the action levels.
- **Step 6 - Specify Acceptable Limits on Decision Errors.** Define the types of errors associated with the data, the consequences of the errors, and the range of acceptable errors. Measurement data are only an estimate of situation at the site. It is important that acceptable data be defined in terms of both false positive and false negative errors. Definition of acceptable errors will lead to development of goals for precision, accuracy, representativeness, completeness, and comparability.

- **Step 7 - Optimize the Design.** Identify the most resource-effective sampling design that will generate data which satisfies steps 1-6 of the DQO process. There are many sets of sampling/analysis schemes that will generate the data needed to adequately address the problem stated in the DQOs. The objective is to design a cost-effective approach to sampling and analysis.

4.1.2 DQO Process for the Bayer New Martinsville RFI

This section briefly describes how the DQO process facilitated project planning for the Bayer New Martinsville RFI. It does not go into detail for each step since the outputs can be seen in various sections of the DOCC Report (ICF Kaiser, 1995a), and this RFI Work Plan.

State the Problem. The primary reason the RFI is being conducted is to identify the nature and extent of constituents in site media that could potentially pose a risk to human health or the environment. Following the RFI, a CMS will be conducted for those media that are identified by the risk assessment as requiring remediation. The goal of remediation at the site will be to reduce any identified risks to acceptable levels. Completion of the RFI and ensuing CMS will fulfill requirements set forth in the facility's HSWA permit. A detailed description of the reasons for the RFI are provided in Section 1 of this work plan. The results of previous investigations are provided in the DOCC Report (ICF Kaiser, 1995a).

Identify the Decision. The primary decision to be made are centered on the following Decisions to be resolved are identified in Sections 2.1 and 2.2 of this work plan. In general, the RFI will to 1) define the nature and extent of any releases posing potential risk to human health and the environment, 2) identify migration potential migration pathways of any releases that pose unacceptable risk to human health or the environment, and 3) characterize the potential risks to human health or the environment posed by exposure to the various affected media. The CMS will evaluate the potential remedies that could reduce these potential risks to acceptable levels.

Identify Inputs. The information needed to resolve the decision statement is provided in the data section needs of this work plan (Section 2.3). Tables 4-1 and 4-2 in the QAPP provides a summary of the data that will be collected and the intended use for the data.

Define Site Boundaries. Section 3 of this work plan provides the locations where geophysical survey data, soil gas data, CMS groundwater data, soil samples, concrete samples, and lagoon water and sediment samples will be collected. All sampling will occur within the Bayer New Martinsville facility property boundaries. Section 4 of the RFI work plan provides a schedule of when data collection will occur. Soil conditions will be evaluated each of the 30 SWMUs and groundwater will be evaluated on a sitewide basis. Lagoon water and sediment conditions will be evaluated at the one SWMU where these media are applicable.

Develop a Decision Rule. The decision rules to be followed during implementation of this RFI are discussed in Section 2.2.3 of this work plan. Decisions will need to be made regarding the need for further characterization, risk assessment, interim measures, and corrective action. Risk assessment will be used as the primary tool for the decision process.

Specify Acceptable Limits on Decision Errors. The uncertainties in the data are controlled via the DQO process described in this section plus the sampling, analytical, validation, and audit procedures described in and the PARCC goals defined in Sections 4.2 through 4.6 of the QAPP (ICF Kaiser,

1995b). In general, two types of data, field engineering measurements and analytical data, will be collected during the Bayer RFI. Field engineering measurements and data uses are provided on Table 4-1. Analytical DQOs were developed and are shown in Table 4-2. A summary of appropriate data uses for analytical DQO's are provided in Table 4-3.

Optimize the Design. Bayer has optimized the design of the RFI through the use of a phased investigation approach that will ensure sufficient data are collected to satisfy all project DQOs. The RFI phases are discussed in Section 2 of this Work Plan.

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TABLE 4-1

DATA USE - FIELD ENGINEERING MEASUREMENTS

FIELD METHOD	DATA OBTAINED	DATA USE
Test Boring Installation	<ul style="list-style-type: none"> - SPT data⁽¹⁾ - Lithology characterization⁽²⁾ - Soil samples for: <ul style="list-style-type: none"> - Particle size - Bulk density - Moisture content - Permeability 	<ul style="list-style-type: none"> - Geologic characterization - Geologic cross sections - Develop remedial alternatives - Contaminant transport modeling
Geophysical Surveys	<ul style="list-style-type: none"> - Subsurface conductivity - Ground-penetrating radar 	<ul style="list-style-type: none"> - Locate subsurface structures and objects - Locate voids - Delineate fill material boundaries - Define hydrogeologic features
Land Survey	<ul style="list-style-type: none"> - Monitoring well elevations - Sample locations 	<ul style="list-style-type: none"> - Basis for locating all site data on base map - Base map for engineering calculations

(1) - Standard Penetration Test in accordance with ASTM D1586-84

(2) - Description of material and Unified Soil Classification System symbol presented on boring logs.

TABLE 4-2

DATA USE - FIELD SAMPLING AND ANALYTICAL COMPONENTS

TASK	ANALYSIS	DATA USE	ANALYTICAL LEVEL ⁽¹⁰⁾
Ground Water Sample Collection	VOCs ⁽¹⁾ , SVOCs ⁽²⁾ , Dioxins, Furans, and selected Metals	Assess nature and extent of contamination in groundwater, risk assessment	III
	pH, Eh, Temperature, Specific Conductivity, TSS ⁽³⁾ , TDS ⁽⁴⁾ , TOC ⁽⁵⁾ , Alkalinity, BOD, COD, Nitrate, total Kjeldahl Nitrogen, Oil and Grease	Monitoring well development, transport evaluation	I
Soil Sample Collection	VOCs, SVOCs, and Metals	Assess nature and extent of contamination in unsaturated zone, risk assessment	III
	TOC, CEC ⁽⁶⁾ , Grain Size Distribution, Moisture Content, Bulk Density, TOX ⁽⁷⁾ , Permeability, BTU Content, Ash Content, Consolidation, Atterburg Limits, Specific Gravity	Transport evaluation and modeling, evaluation of remedial technologies for the unsaturated zone	III
	pH	Transport evaluation	III
	Ignitability, Reactivity, Corrosivity, TCLP ⁽⁸⁾ Metals	Determine if RCRA hazardous waste	III
Concrete Chip Sampling	VOCs, SVOCs, and Metals	Assess nature of potential contamination in the concrete, risk assessment	III
Lagoon Water and Sediment Sampling	VOCs, SVOCs, and Metals	Assess nature and extent of potential contamination in lagoon water and sediment	III
Soil Gas Survey	Selected VOCs	Preliminary screening data used to locate test borings	II
OVM ⁽⁹⁾ Field Screening	Total VOCs	Screening data for selection of samples to submit to laboratory	I

(1) Volatile Organic Compounds

(2) Semivolatile Organic Compounds

(3) Total Suspended Solids

(4) Total Dissolved Solids

(5) Total Organic Carbon

(6) Cation Exchange Capacity

(7) Total Organic Halogens

(8) Toxicity Characteristic Leading Procedure

(9) Organic Vapor Monitor

(10) See Table 4-3 for DQO Criteria

TABLE 4-3
SUMMARY OF APPROPRIATE DATA USES FOR ANALYTICAL LEVELS

Data Type	Analytical Level	Type of Analysis	Limitations	Data Uses	Data Quality
Screening	Level I	<ul style="list-style-type: none"> - Total Organic/Inorganic Vapor Detection using portable instruments - Field test kits 	<ul style="list-style-type: none"> - Instruments respond to naturally-occurring volatile organic compounds 	Site characterization, monitoring during implementation	<ul style="list-style-type: none"> - If instruments are calibrated and data interpreted correctly, can provide indication of contamination
Screening or Definitive	Level II	<ul style="list-style-type: none"> - Variety of organics by GC; Inorganics by AA; XRF⁽¹⁾ - Tentative identification; analyte-specific - Detection limits vary from low ppm to low ppb 	<ul style="list-style-type: none"> - Tentative identification - Techniques/instruments limited mostly to volatiles, metals 	Site characterization, evaluation of alternatives, engineering design, monitoring during implementation	<ul style="list-style-type: none"> - Dependent on QA/QC steps employed - Data typically reported in concentration ranges
Definitive	Level III	<ul style="list-style-type: none"> - Organics/Inorganics using EPA Procedures other than CLP; can be analyte-specific - RCRA Characteristic Tests 	<ul style="list-style-type: none"> - Tentative identification in some cases - Can provide data of same quality as level IV 	Risk assessment, site characterization, evaluation of alternatives, engineering design monitoring during implementation	<ul style="list-style-type: none"> - Similar detection limits to CLP - Less rigorous QA/QC
Definitive	Level IV	<ul style="list-style-type: none"> - TCL/TAL Organics/Inorganics by GC/MS; AA; ICP - Low ppb detection limit 	<ul style="list-style-type: none"> - Tentative identification of non-TCL parameters - Some time may be required for validation of packages 	Risk assessment, Evaluation of Alternatives, Engineering Design	<ul style="list-style-type: none"> - Data of known quality - Rigorous QA/QC
Definitive	Level V	<ul style="list-style-type: none"> - Non-conventional parameters - Method-specific detection limits - Modifications of existing methods - Appendix IX parameters 	<ul style="list-style-type: none"> - May require method development/modification - Mechanisms to obtain services requires special lead time 	Risk Assessment	<ul style="list-style-type: none"> - Method-specific

⁽¹⁾ GC - Gas chromatography
AA - Atomic adsorption
XRF - X-ray Fluorescence
TCL - Target Compound List
TAL - Target Analyte List
MS - Mass Spectrometer
ICP - Induced Coupled Plasma

4.2 PRECISION

Precision refers to the level of agreement among repeated measurements of the same parameter. It is usually stated in terms of standard deviation, relative standard deviation, relative percent difference, range, or relative range. The overall precision of a piece of data is dependent upon both sampling and analytical factors. The analytical precision is much easier to control and quantify because the laboratory is a controlled, and therefore measurable environment. Sampling precision is unique to each site, making it much harder to control and quantify. The goals for each factor are addressed here separately.

Sampling precision will be checked by obtaining a duplicate sample for every 20 samples collected for each type of media. Precision will be evaluated by calculating the relative percent difference (RPD) as follows:

$$RPD = \frac{\text{difference between the two measured values}}{\text{average of the two measured values}}$$

The RPD will be calculated for each analytical parameter. For the project DQOs to be met, it is expected that the duplicates will have RPDs of $\leq 35\%$ for water and $\leq 50\%$ for soils. If this criterion is not met, a careful examination of the sampling techniques, sample media, and analytical procedure will be conducted to identify the cause of the high RPD and determine the usability of the data.

Laboratory precision will be evaluated by the analysis of duplicate samples at a frequency of one duplicate per 20 samples for organic analyses and one per 20 samples for metals and conventional analyses. The RPD for each analytical parameter will be calculated as a measurement of precision. For analyses conducted using the SW-846 organic or inorganic methods, the RPD criteria as specified in SW-846 are hereby adopted. An RPD of $\leq 35\%$ is adopted for all other analyses. If these criteria are not met, a careful examination of the sampling techniques, sample media, and analytical procedure including equipment, calibration, and reagents will be conducted to identify the cause of the high RPD and define the usability of the data.

4.3 ACCURACY

Accuracy refers to the difference between a measured value for a parameter and the true value for the parameter. It is an indicator of the bias in the measurement system. Sources of error measured by this parameter include the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical technique.

The sampling accuracy will be assessed by collecting one field blank each day for samples that are taken for each type of media, and one trip blank for each sample shipment that contains samples to

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be analyzed for volatile organics. The accuracy goal for the trip and field blanks will be that they contain less than the method detection limit for each analytical parameter. If analytes are detected in the blanks above these levels, the sample data will be compared with the blank data and may be rejected or qualified, depending on the relative amounts present.

Laboratory accuracy will be evaluated using blank and spiked samples. For samples being analyzed using SW-846 methods, the spike acceptance criteria specified in SW-846 are adopted. The goal for volatile and semivolatile method blanks is that they contain no more than the detection limit for target compounds and no more than five times the detection limit of common lab contaminants including methylene chloride, acetone, 2-butanone, and phthalate esters. The inorganic method blanks must contain less than the detection limit for each analyte. The accuracy goals for all other analyses are set at 50% to 150% for the spike recoveries and less than the method detection limit for the blanks. If these criteria are not met, a careful evaluation of the data will be performed to determine the source of the error and usability of the data.

4.4 REPRESENTATIVENESS

Representativeness is a measure of the degree to which the measured results accurately reflect the medium being sampled. It is a qualitative parameter that is addressed through the proper design of the sampling program in terms of sample location, number of samples, and actual material collected as a sample of the whole.

Sampling protocols (discussed in Section 5 of this document) have been developed to assure that samples collected are representative of the media. In addition, the laboratory has established sample preparation protocols (included in Appendix A of this document) to assure that aliquots of the sample used for analysis are representative of the sample as submitted from the field. Field and laboratory handling protocols (e.g., storage, handling in the field, and shipping) have also been designed to protect the representativeness of the collected samples. Proper field documentation will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

4.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. When comparing data, it is important to compare data collected under the same set of conditions. Seasonal trends, depth of sample collection, analytical protocol, stream flow during sample collection, and any other sampling/analytical variables must be taken into account when comparing data sets. Comparability of data collected during the RFI will be accomplished by using established USEPA methods for collecting and analyzing the samples, and documenting the methods used.

4.6 COMPLETENESS

Completeness is a measure of the amount of information that must be collected during the field investigation to allow for successful achievement of the project objectives. A certain amount and type of data must be collected for the waste characterization to be valid. Missing data may reduce the precision of estimates or introduce bias, thus lowering the confidence level of the conclusions.

For this project, the completeness goals are 90% for the field sampling and 90% for the laboratory analysis. While completeness has historically been presented as a percentage of the data that is

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considered valid, this does not take into account critical sample locations or critical analytical parameters. The amount and type of data that may be lost due to sampling or analytical error cannot be predicted or evaluated in advance. The importance of any lost or suspect data will be evaluated in terms of the sample location, analytical parameter, nature of the problem, decision to be made, and the consequence of an erroneous decision. Critical locations or parameters for which data are determined to be inadequate may be resampled.

Procedure

1. At the desired location, clear any surface debris (e.g., vegetation, rocks, twigs).
2. Using a scoop or trowel, collect an adequate portion of soil from a depth of 0-6 inches and place in the bowl.
3. Place samples that will be analyzed for VOCs directly into the appropriate sample container without mixing or homogenizing. Fill sample containers for VOCs analysis with no or minimal head space. For other analyses, collect additional material and homogenize the sample in the stainless steel bowl by stirring it with a scoop or trowel.
4. Transfer the sample directly into appropriate remaining sample container using a scoop or trowel.
5. Cap and tighten the sample container and affix a label to the container. The samples will be placed on ice and cooled to 4°C immediately after they are collected. Place sufficient ice with the samples to ensure they are cooled to and will maintain a maximum temperature of 4°C prior to shipment to an off-site laboratory or delivery to Bayer ETS.
6. Using the engineers rule, measure the depth of the sample taken and record it in a field notebook and sample log sheet. Notes should also include sample description, color, location, time, date, samplers initials, and parameter(s) to be analyzed.

Precautions

- Do not handle a sample with anything but a sampling implement.
- Do not homogenize or composite the portion of the sample for VOCs analysis.

5.2 SUBSURFACE SOIL SAMPLE COLLECTION

Scope and Application

Subsurface soil sampling supplies information on subsurface lithology as well as providing materials for use in evaluating the vertical and horizontal extent of contamination. Two methods of collecting subsurface samples are presented as follows:

1. Split-Barrel Sample Collection - Applicable for collecting relatively undisturbed soil samples in difficult soils or at depths of 5 feet or greater. This method may also be used for shallow (less than 5 feet) depths.
2. Shelby Tube Sample Collection - Applicable for collecting relatively undisturbed soil samples in soft soils. Suitable for laboratory tests for physical properties.

6. Place samples that will be analyzed for VOCs directly onto the appropriate sample container without homogenizing or mixing. Fill sample containers for VOCs analysis so that no or minimal head space is present in the sample container. Place sample in a stainless steel bowl and thoroughly homogenize the sample by mixing with a spoon. Fill the appropriate sample containers with the remaining homogenized sample.
 - a. Record the following information in the field logbook and on the Sample Log Sheet (Appendix C):
 - Sample Date, Time and Number
 - Type of Sample
 - Location
 - Sampled By
 - Sample Interval
 - Sample Method
 - Field Screening Instrument Readings
 - Saturation Recovery
 - Any Other Pertinent Information

7. Cap and tighten the sample container and affix a label to the container. The samples will be placed on ice and cooled to 4°C immediately after they are collected. Place sufficient ice with the samples to ensure they are cooled to and will maintain a maximum temperature of 4°C prior to shipment to an off-site laboratory or delivery to Bayer ETS.

Precautions

- Do not handle a sample with anything but a sampling implement.

Shelby Tube Sample Collection

Summary of Method

A Shelby Tube will be pressed into soil below the lead auger to obtain a relatively undisturbed soil sample. The ends of the tube will be sealed with plastic caps, tape and wax after sampling to prevent the soil from being disturbed and to maintain its moisture content and in-situ soil characteristics.

Equipment

- Decontaminated shelby tube samplers
- Drill rig and accessories

Procedure

Collect Shelby Tube samples according to ASTM Method D1587-83, "Standard Practice for Thin-Walled Tube Sampling of Soils," presented in Appendix B of this QAPP. Record in the field notebook the depth interval at which the Shelby Tube was taken. After the Shelby Tube and sample are retrieved from the hole, record the percent sample recovery (actual length of soil in the tube divided by the length the tube was pushed) in accordance with ASTM D1587-83 and the method of

sealing the tube in the field notebook. Mark sample name, collection date and orientation of sample on tube with a permanent marker and keep tubes upright during shipment.

1. Record the following information in the field logbook and on the Sample Log Sheet (Appendix C):

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slowly should be purged at a rate of less than one gallon per minute. If the well is purged to near dryness using this slow rate, allow it to recover and collect a sample.

5. Sample the well within four hours of purging, if possible. Slow recharging wells are permitted to sit overnight (maximum 24 hours) prior to sample collection.
6. Remove the pump and collect the sample from the well with a stainless steel or teflon bailer. Pour the sample from the bailer into the appropriate container.
7. Add the appropriate preservative immediately following sample collection prior to shipment to the laboratory. Cap and tighten the sample container and affix a label to the container. The samples will be placed on ice and cooled to 4°C immediately after they are collected. Place sufficient ice with the samples to ensure they are cooled to and will maintain a maximum temperature of 4°C prior to shipment to an off-site laboratory or delivery to Bayer ETS.
8. Pour a portion of the sample from the bailer into a container and measure pH, temperature and conductivity.
9. Replace the well cap and secure the cover.
10. Record the following purge and sample data in the field notebook and on the sampling form provided in Appendix C.
 - Well Number
 - Sample Number
 - Sample Date and Time
 - Type of Sample
 - Location
 - Total Depth of Well
 - Well Casing Size and Type
 - Static Water Level
 - One Casing Volume
 - Purge Start and End Time
 - Total Purge Time (minutes)
 - Total Amount Purged
 - Field Screening Device Reading
 - Purge Method
 - Sample Depth
 - Sampled By
 - pH
 - Temperature
 - Color and Turbidity
 - Specific Conductivity

Precautions

- Sampling of groundwater from monitoring wells will be conducted no sooner than 7 days following the development of the newly installed monitoring wells.
- Follow Subsection 5.8 when groundwater samples are to be filtered.

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5. Run replicate analyses on the number of samples specified in the RFI Work Plan.
6. Visually inspect chromatograms for errors that may affect the validity of the data. A sample or particular component may be eliminated from consideration on the basis of visual judgment. Examples of elimination criteria include badly skewed or tailing peaks, failure of the integrator to properly separate closely eluting or tailing peaks, and the presence of transient peaks that mask or interfere with the proper quantification of a peak of interest. A trained analytical chemist should make notes directly on the chromatogram recording the reason for the elimination of data points or runs. Samples deemed invalid will be recollected at the discretion of the field operations leader.
7. Enter appropriate readings and field and analytical laboratory results on the Soil Gas Data form (Appendix C). Associated documentation concerning lab blanks, standards, field blanks, and replicates will be delivered to the field manager.
8. Before leaving the soil sampling location, it is recommended that a final check be performed to ensure:
 - The location is marked for future reference with a stake or flagging;
 - Adequate QC samples have been collected;
 - Documentation is complete; and
 - The probe is removed from the location and probe hole filled in with native material or bentonite chips.
9. Decontaminate equipment prior to leaving site in accordance with Section 5.14.
10. The calibration will be verified every ten samples or daily, ~~whichever is more frequent~~. A check standard will be injected before and after each group of ten samples. The percent difference between the average response factor and the check standard response factor must be $\leq 20\%$. Alternatively, the check standard concentration as determined from the calibration curve must fall within 80 to 120% of the true value. The check standard will be rerun for any compound that fails. If the failure is repeated, the problem must be corrected before analyzing any samples. This includes recalibration if needed.

Precaution

- GC should be reviewed by a trained analytical chemist for errors that may affect the validity of the data.

5.10 FIELD FILTRATION OF SAMPLES

Scope and Application

Groundwater samples collected in accordance with Subsection 5.3 may be filtered in preparation for dissolved metals analysis. In-line filtration will be performed using the following procedures if

filtering is required using a 0.45 μ m filter.

Summary of Method

Sample water is extracted from the well and collected into a transfer bottle. A peristaltic pump, with an in-line filter connected to the end of the discharge tube will be used to filter the sample.

Equipment

- QuickFilters (polypropylene housing, organic polymer membrane) or equivalent. (Size of pore to be determined in RFI Work Plan.)
- Pump (peristaltic)
- Polyethylene discharge tubing or equivalent
- Appropriately sized fittings to allow for filter connection

Procedure

1. Purge the well, then collect groundwater with a stainless steel or teflon bailer and transfer into an unpressured transfer bottle.
2. Attach a new filter to the peristaltic pump line.
3. Turn on the pump and adjust the discharge rate, if necessary.
4. Fill the desired sample bottles with the filtered liquid. Operating pressure may be increased slightly if faster flow is desired, but do not increase the pressure beyond 60 psi.
5. If the filter becomes completely plugged, install a new filter and proceed to collect additional sample.
6. Add the proper preservative to each sample bottle.
7. Discard the filter in accordance with Section 5.13 of this QAPP.

Precautions

- Do not increase pump operating pressure beyond 60 psi in order to prevent housing or membrane failure and sample contamination.

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TABLE 8-1 (continued)

ANALYTICAL METHODS

<u>Matrix</u>	<u>Parameter</u>	<u>Method</u>	<u>Reference</u>	<u>Detection Limit</u>
Soil	Bulk Density - Laboratory	5372	USBR ⁽⁸⁾	N/A
Soil	Sulfide	9030	SW 846	20 mg/kg
Soil	Ammonia-300	351.3	EPA 600	2.5 mg/kg
Soil	Sulfate	9038	SW 846	4.0 mg/kg
Soil	Chloride	9252	SW 846	4.0 mg/kg
Soil	Boron	200.7	EPA 600	10 mg/kg
Water	VOCs	SA-6 8260	Miles SW 846	Variable ⁽³⁾
Water	SVOCs	SA-3 8270	Miles SW 846	Variable ⁽⁴⁾
Water	PCBs/Pesticides	SA-8 8080	Miles SW 846	Variable ⁽⁴⁾
Water	Mercury (Hg)	7470	SW 846	0.2 µg/l
Water	Metals (except Hg)	SA-44 & SA-45 6000/7000	Miles SW 845	Variable ⁽⁴⁾
Water	TPH	418.1	EPA 600	1 mg/l
Water	pH	9045	SW 846	N/A
Water	Eh	D1498	ASTM	N/A
Water	TSS	160.2	EPA 600	1 mg/l
Water	TDS	160.1	EPA 600	1 mg/l
Water	Ammonia	350	EPA 600	0.05 mg/l
Water	Sulfate	9038	SW 846	1 mg/l
Water	Chloride	9250	SW 846	1 mg/l
Water	Boron	212.3	EPA 600	0.1 mg/l

- (1) Miles ETS analytical procedures are included in Appendix B-1 and are similar to EPA SW 846 methods.
- (2) SW 846 Test Methods for Evaluating Solid Waste Physical/Chemical Methods.
- (3) Compound specific detection limits are provided in the method description in Appendix B-1.
- (4) Compound specific detection limits are provided in the method description in EPA SW 846.
- (5) Methods for Chemical Analysis of Water and Wastes, EPA 0 600/4-79-020.
- (6) ASTM - American Society for Testing and Materials.
- (7) SM - "Standard Methods for the Examination of Water and Wastewater", 17th Edition.
- (8) USBR - United States Bureau of Reclamation.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

Data reduction, QC review, and reporting will be the responsibility of the analytical laboratory and is discussed in Section 9.1. Data assessment, including a formal data validation procedure, will be conducted by ICF Kaiser. They will also conduct data reduction to facilitate the use of raw data in site evaluations. This process is discussed in Section 9.2.

9.1 DATA REDUCTION AND REPORTING

Data Reduction

Data reduction includes all automated and manual processes for reducing or organizing raw data generated by the laboratory. For all published and referenced methods, the laboratory must adhere to the requirements of the method for calculation of results. Further details are presented in Section 10 of Miles ETS' QA/QC program, which is attached to this document as Appendix A. The laboratory will provide a CLP-type data package for organic and metal analyses with a DQO of Level IV. Data packages for all other analyses will include calibration, blanks, duplicates, spikes, calculations, a copy of the raw data, and any other information needed to check and recalculate the analytical results.

9.2 DATA VALIDATION

Once a data package is received from the laboratory, the analytical results and pertinent QA/QC data will be compiled onto standardized data spread sheets. The spread sheets will serve as basic reference sheets for data validation, as well as for project data use.

Prior to releasing data for use by project staff, selected data will undergo data validation based on intended end use of the data. Key decision making data points, as selected by the project manager, with approval of the EPA Project Manager, will be validated. Those data points chosen for validation will be examined to determine laboratory compliance with QA requirements and other factors that determine the quality of the data. After the determination of data quality, a determination will be made by the validator as to the usability of the data for its intended purpose. If the data is determined not to be usable, a decision will be made whether to resample, reanalyze, or continue the investigation without this data. All validation will be performed by the Supervising Contractor.

If out-of-control data points or data omissions are identified during the data validation, this data will be evaluated to judge the impact on the project. If necessary, samples will be reanalyzed, providing holding time criteria are not exceeded. Other corrective action may include resampling and analyzing, evaluating and amending sampling and analytical procedures and accepting data acknowledging the level of uncertainty.

SW-846 Organic and Inorganic Data

Organic and inorganic data validation will be performed in accordance with The National Functional Guidelines for Evaluating Organic and Inorganic Analyses, as modified by USEPA Region III. At a minimum, the following factors will be examined:

Trace Element Analysis

Method SA-45 (Graphite Furnace / Atomic Absorption Spectroscopy)

1.0 Scope and Application

1.1 This method is applicable for the determination of dissolved, suspended or total metals in drinking, surface, and saline waters, groundwater, domestic and industrial wastewaters, and mobility procedure extracts.

1.2 This method is also applicable to the determination of total metals in soils, sediments, sludges, and other solid wastes, after an appropriate digestion has been performed.

1.3 Dissolved elements are determined in filtered and acidified samples. Appropriate steps are taken in all analyses to ensure that potential interferences are taken into account. This is especially true when dissolved solids exceed 1500 mg/L.

1.4 Total elements are determined after appropriate digestion procedures are performed. Since digestion techniques increase the dissolved solids content of the samples, appropriate steps must be taken to correct for potential interference effects.

1.5 While this technique is generally applicable to a wide variety of metals, the method is specifically intended for the analysis of antimony, arsenic, lead, selenium, and thallium. Table 1 lists these metals along with the recommended wavelengths for quantitation and instrumental detection limits. Actual working detection limits are sample dependent and as the sample matrix varies these concentrations may also vary.

2.0 Summary of Method

2.1 A representative aliquot of the sample or digestate is placed in the graphite tube in the furnace, evaporated to dryness, charred, and atomized. Radiation from a given excited element is passed through the vapor containing ground-state atoms of that element. The intensity of the transmitted radiation decreases in proportion to the amount of the ground-state element in the vapor. A monochromator isolates the characteristic radiation from the hollow cathode lamp and a photosensitive device measures the attenuated transmitted radiation.

2.2 Additional preparation steps may be required in order to convert organic forms of metals to inorganic forms and to minimize organic interferences, particularly for arsenic and selenium. Matrix modifiers may also be necessary.

3.0 Interferences

3.1 Interferences can be chemical or spectral in nature. Chemical interferences can be minimized by matrix modification and by appropriate use of digestion techniques. Spectral interferences can be overcome by using Zeeman background correction or by using an alternate wavelength line for detection.

3.2 The absence of interferences can be verified by using the serial dilution technique (section 8.6). When an interference is discovered, samples must be analyzed by the method of standard additions (section 8.7).

3.3 Nitric acid is preferable for all work with graphite furnaces. If any other acid is required, a minimum amount should be used. This applies particularly to hydrochloric and, to a lesser extent, sulfuric and phosphoric acids.

3.4 Samples containing large amounts of organic matter may be oxidized by conventional acid digestion before being placed in the furnace in order to minimize broad-band absorption.

3.5 Pyrolytic graphite and Zeeman background correction will be used for all analyses.

3.6 Since glassware contamination is a severe problem for lead analysis, all glassware will be cleaned immediately prior to use according to the procedure in Bayer SOP-2.

3.7 High lead concentrations may cause a spectral interference with the determination of antimony on the 217.6-nm line. If this interference is expected and not minimized by Zeeman correction, the secondary wavelength for antimony may be employed.

3.8 Elemental arsenic and selenium and many of their compounds are volatile and subject to losses during sample handling steps and analysis. Caution must be employed during selection of sample preparation methods and the temperature and times for the dry and char (ash) cycles. A palladium solution must be added to all digestates prior to analysis to minimize volatilization losses during drying and ashing.

4.0 Apparatus

4.1 Perkin Elmer Model PE5100 atomic absorption spectrophotometer, equipped with a computerized data collection and processing system and an AS-60 autosampler, or equivalent. Argon is used as the purge gas.

4.2 Electrodeless discharge lamps: Supplied by Perkin Elmer.

4.3 Perkin Elmer Model graphite furnace, or equivalent: Capable of reaching the temperatures specified in the method and having Zeeman background correction.

4.4 Pipets, microliter, 5- to 100- μ L, as required.

4.5 Volumetric flasks, bottles, and containers, plastic or glass, various capacities.

5.0 Reagents and Standards

5.1 Nanopure® II water, or equivalent ASTM Type II reagent water.

5.2 Acids used in the preparation of standards and for sample processing are ultra-high purity grade, Ultrex®, J. T. Baker.

5.2.1 Hydrochloric acid, conc.

5.2.2 Hydrochloric acid solution, (1:1): Add 500 mL conc. HCl to 400 mL Nanopure II water and dilute to 1 liter.

5.2.3 Nitric acid, conc.

5.2.4 Nitric acid solution, (1:1): Add 500 mL conc. nitric acid to 400 mL Nanopure II water and dilute to 1 liter.

5.3 Standard stock solutions: Purchased from various vendors including Perkin Elmer, Spex, and Leeman Labs, Inc. Lead stock solution is prepared by dissolving 1.599 g of lead nitrate $\text{Pb}(\text{NO}_3)_2$ in Nanopure II water, adding 10 mL of concentrated nitric acid, and diluting to 1 L; 1 mL = 1 mg Pb (1000 mg/L).

5.4 Calibration standards: Prepared by the appropriate dilution of the standard stock solutions and containing the same amounts of acids as the samples, normally 0.2% nitric acid. The calibration curve must consist of four standards and a blank, and these solutions must be prepared fresh daily.

5.5 Two types of blanks may be required for the analysis. The calibration blank is used in establishing the analytical curve while the reagent blank is used to correct for possible contamination resulting from varying amounts of the acids used in the sample processing.

5.5.1 The calibration blank is prepared by diluting (1:1) nitric acid with Nanopure II water to a final concentration of 0.2%. Prepare a sufficient quantity to be used to flush the system between standards and samples.

5.5.2 The reagent blank will contain all the reagents and in the same volumes as used in the processing of the samples. The reagent blank will be carried through the complete procedure and contain the same acid concentration in the final solution as the sample solution used for analysis.

5.6 Palladium matrix modifier: Prepared by dissolving 0.75 g Pd and 0.50 g magnesium nitrate, $\text{Mg}(\text{NO}_3)_2$, in 100 mL of 5% (v/v) nitric acid.

5.7 Phosphate matrix modifier: Prepared by dissolving 0.2 mg ammonium dihydrogen phosphate, $\text{NH}_4\text{H}_2\text{PO}_4$, and 0.01 mg $\text{Mg}(\text{NO}_3)_2$ per mL of 5% nitric acid.

5.8 Sulfuric acid matrix modifier: Prepared to be 1% (w/w) H_2SO_4 in water.

6.0 Sample Handling and Preservation

6.1 For the determination of trace elements, contamination and loss are of prime concern. Dust in the laboratory environment, impurities in reagents and impurities on laboratory apparatus which the sample contacts are all sources of potential contamination. Sample containers can introduce either positive or negative errors in the measurement of trace elements by (a) contributing contaminants through leaching or surface desorption and (b) by depleting concentrations through adsorption. Thus the collection and treatment of the sample prior to analysis requires particular attention. Laboratory glassware including the sample bottle must be thoroughly washed according to the procedure outlined in Bayer SOP-2.

Note 1

Chromic acid must not be used for cleaning glassware!

6.2 Before collection of the sample, a decision must be made as to the type of data desired, i.e. dissolved, suspended or total concentration of the metal(s) in question so that the appropriate preservation and

pretreatment steps may be accomplished. Filtration, acid preservation, etc., are to be performed at the time the sample is collected or as soon as possible thereafter.

6.2.1 For the determination of dissolved elements the sample must be filtered through a 0.45- μ m membrane filter as soon as practical after collection. Glass or plastic filtering apparatus will be used to avoid possible contamination. The first 50-100 mL will be used as a rinse for the filter flask and will be discarded. After collection of the required volume, the filtrate will be acidified with (1:1) nitric acid to a pH of 2 or less. (Normally, 3 mL of (1:1) nitric acid per liter is sufficient to preserve the sample.)

6.2.2 For the determination of suspended elements, a measured volume of unpreserved sample will be filtered through a 0.45- μ m membrane filter as soon as practical after collection. The filter plus suspended material will be transferred to a suitable container for storage and/or shipment. No preservative is required.

6.2.3 For the determination of total or total recoverable elements, the sample is acidified with (1:1) nitric acid to pH 2 or less as soon as possible, preferably at the time of collection. The sample is not filtered before processing.

6.3 Samples should be refrigerated at 4 °C during storage.

7.0 Sample Preparation

7.1 For the determinations of dissolved elements, the filtered, preserved sample may often be analyzed as received. The acid matrix and concentration of the samples and calibration standards will be the same. (See Note 3.) If a precipitate formed upon acidification of the sample or during transit or storage, it will be redissolved before the analysis by adding additional acid and/or by heat.

7.2 Except in unusual cases, microwave digestion is used when total metal concentrations are required; Method SP-16 is used for aqueous samples and Method SP-12 is used for solids and sludges.

7.3 For the determination of suspended elements, transfer the membrane filter containing the insoluble material to a 150-mL Griffin beaker and add 4 mL conc. nitric acid. Cover the beaker with a watch glass and heat gently. The warm acid will dissolve the membrane. Increase the temperature of the hot plate and digest the material. When the acid has nearly evaporated, cool the beaker and watch glass and add another 3 mL of conc. nitric acid. Cover and continue heating until the digestion is complete, generally indicated by a light colored digestate. Evaporate to near dryness (2 mL) and cool. Wash down the watch glass and beaker walls with Nanopure II water and filter the sample to remove insoluble material. (See Note 2.) Adjust the volume so that the expected concentration of each element falls on the linear portion of the element's calibration curve. This volume will vary depending on the elements to be determined. (See Note 3.) The sample is now ready for analysis. Concentrations so determined will be reported as "suspended."

Note 2

In place of filtering, the sample, after diluting and mixing, may be centrifuged or allowed to settle by gravity overnight to remove insoluble material.

Note 3

If the sample analysis solution has a different acid concentration from that given in section 9.5, but does not introduce a physical interference or affect the analytical result, the same calibration standards may be used.

8.0 Procedure

8.1 The instrument is set up following the manufacturer's instructions. The instrument is operated 45 min prior to calibration. See Table 2 for specific instrument parameters for the metals of interest.

8.2 The instrument is calibrated with at least four standards and a blank following the manufacturer's recommended procedures, using the calibration standard solutions described in section 5.4. The system is flushed with the calibration blank (see section 5.5.1) between each standard. *The use of the average intensity of multiple exposures for both standardization and sample analysis has been found to reduce random error.*

8.3 The highest calibration standard will be analyzed as if it were a sample before beginning the sample run. Concentration values obtained should not deviate from the actual values by more than ± 5 percent (or the established control limits, whichever is lower). If they do, the condition must be corrected before samples can be analyzed.

8.4 The sample run is started. The calibration blank solution (see section 5.5.1) is run between each sample to flush the system. A calibration verification standard and the calibration blank (see section 5.5.1) are run each 10 samples.

8.5 The matrix modifier solution is added automatically during each sample run. The typical amount of modifier added is 5 μ L per 40 μ L of sample; however, this amount varies with the concentration of the analyte and with the matrix. The palladium modifier is used for the analysis of antimony, arsenic, and selenium, the phosphate modifier is used for lead, and the sulfuric acid modifier is used for thallium.

8.6 When appropriate, the Method of Serial Dilutions is applied.

8.6.1 To apply the Method of Serial Dilutions, the concentration of the analyte should be at least 25 times the detection limit. Determine the apparent concentration in the undiluted sample.

8.6.2 Dilute the sample five-fold and reanalyze for the analyte(s) of interest.

8.6.3 Calculate the percent difference between the two values. If the difference is greater than 10%, an interference is indicated. A second five-fold dilution may be performed; the standard deviation must be below 10% for the sample to be considered free of interferences. The Method of Standard Addition should be performed for cases involving matrix interferences.

8.7 When appropriate, the Method of Standard Addition is applied. The standard addition technique involves preparing new standards in the sample matrix by adding known amounts of standard to one or more aliquots of the processed sample solution. The technique compensates for a sample component that enhances or depresses the analyte signal, producing an analytical response different from that of the calibration standards. The single-addition method is described below.

8.7.1 Two sample aliquots are prepared and a small amount of standard solution is added to the second aliquot. The volume of solution added must be small compared to the initial volume of the aliquot and the amount of standard added should approximately double the analytical response of the sample.

8.7.2 The sample aliquot is analyzed and the spectrophotometer is set to zero.

8.7.3 The aliquot with the standard addition is analyzed and the spectrophotometer is set to the concentration of the standard addition.

8.7.4 The calibration blank is analyzed and the analytical result is a negative reading, the absolute value of which will be the unknown sample concentration.

Note 4

There is a maximum negative reading which can be obtained on the instrument. Care must be taken to ensure that this value is not exceeded.

9.0 Calculations

9.1 Apply the appropriate dilution factor, if necessary.

9.2 Data will be rounded to the thousandths place and all results will be reported in $\mu\text{g/L}$ or mg/kg with up to three significant figures.

9.3 Data for solids will be reported as wet weight, unless otherwise stated. Percent moisture content will be determined according to the procedure in Method SP-3, section 8.0, and will also be reported, when appropriate.

10.0 Quality Control (Instrumental)

10.1 A mid-range calibration solution containing the elements of interest will be analyzed at a frequency of 10% as a verification of the calibration. This standard will determine instrument drift. If agreement is not within $\pm 10\%$ of the expected values or within the established control limits, whichever is lower, the analysis will be deemed out of control and the analysis of samples terminated until the problem is corrected. The instrument will then be recalibrated.

10.2 The calibration blank (see section 5.5.1) will be analyzed at a frequency of 10%. The result should be within the established control limits of 3 standard deviations of the mean blank value. If not, the analysis will be repeated two more times and the results averaged. If the average is not within the control limit, the analysis will be terminated and the problem corrected. The instrument will be recalibrated prior to the analysis of additional samples.

10.3 A laboratory control sample prepared from NIST reference materials or EPA-certified standards is used for the verification of the calibration standards. A freshly prepared sample is analyzed each day to monitor the stability of the standards. If the results are not within $\pm 20\%$ of the true value (except for antimony, which has no control limits), new calibration standard(s) are prepared and the instrument recalibrated. If this does not correct the problem, a new stock standard will be obtained and a new calibration standard prepared. The calibration step will then be repeated.

10.4 A duplicate will be analyzed for every 20 samples in a batch. The duplicate is brought through the entire sample preparation procedure. The relative percent difference between the sample and its duplicate must be less than 10% for analyte concentrations greater than 5 times the required detection limits, or else corrective action must take place.

10.5 A matrix spike sample will be analyzed for every 20 samples in a batch. The spike is brought through the entire sample preparation procedure and should be at a level greater than 5 times the required detection limit. The percent recovery of the spike must be in the range 75 - 125%, or else corrective action must take place.

11.0 Precision and Accuracy

11.1 Table 3 lists precision and accuracy values taken from Method 200.9, EPA/600/4-91/010, for metals in different matrices. These values are intended to be for illustration only.

12.0 References

12.1 Methods 7000A and 7060A, SW-846, 3rd Edition, Update I.

12.2 Methods 7041, 7421, 7740, and 7841, SW-846, 3rd Edition.

12.3 Method 200.9, EPA/600/4-91/010, June, 1991.

Table 1

Recommended Wavelengths¹ and Estimated Instrumental Detection Limits

Element	Wavelength, nm	Estimated MDL, $\mu\text{g/L}$
Antimony	217.6 primary	1
	231.1 secondary	
Arsenic	193.7	1
Lead	283.3 primary	0.5
	217.0 secondary ²	
Selenium	196.0	2
Thallium	276.8	1

¹The wavelengths listed are recommended because of their sensitivity and over all acceptance. Other wavelengths may be substituted if they can provide the needed sensitivity and are treated with the same corrective techniques for spectral interference.

²Greater sensitivity can be achieved using the 217.0-nm line, but the optimum concentration range is reduced. The use of a lead electrodeless discharge lamp at this lower wavelength has been found to be advantageous. Also, a lower atomization temperature (2400 °C) may be preferred.

Table 2

Instrument Parameters¹

<u>Metal</u>	<u>Ramp</u>	<u>Hold</u>	<u>Temp.</u>
Drying Cycle			
All metals	5 seconds	40 seconds	120 °C
Ashing Cycle			
Antimony	5 seconds	20 seconds	1100 °C
Arsenic	10 seconds	20 seconds	1250 °C
Lead	5 seconds	30 seconds	800 °C
Selenium	10 seconds	20 seconds	1100 °C
Thallium	5 seconds	20 seconds	600 °C
Cooling Cycle			
Antimony	1 second	12 seconds	20 °C
Arsenic	1 second	12 seconds	20 °C
Lead	1 second	15 seconds	20 °C
Selenium	1 second	12 seconds	20 °C
Thallium	1 second	10 seconds	20 °C
Atomizing Cycle			
Antimony	0 seconds	5 seconds	2200 °C
Arsenic	0 seconds	5 seconds	2250 °C
Lead	0 seconds	4 seconds	1650 °C
Selenium	0 seconds	5 seconds	2150 °C
Thallium	0 seconds	5 seconds	1400 °C
Cleaning Cycle			
All metals	1 second	5 seconds	2600 °C

¹Based on the use of a 20- μ L (32- μ L for Tl) injection, purge gas interrupt, and pyrolytic graphite with platform.

Table 3**Precision and Accuracy Data
NBS River Sediment 1645**

<u>Element</u>	<u>Expected Conc., mg/kg</u>	<u>Conc., mg/kg</u>	<u>% RSD</u>
Antimony	51	25.8	8.2
Arsenic	66	69.2	3.4
Selenium	1.5	0.7	20.4

Spiked Well Water

<u>Element</u>	<u>Spike Conc., $\mu\text{g/L}$</u>	<u>Percent Rec.</u>	<u>% RSD</u>
Antimony	25	114.3	1.2
Arsenic	10	101.6	2.1
Lead	25	102.2	0.7
Selenium	25	95.9	1.2
Thallium	50	98.0	1.4